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PRACTICAL
HEALTH LESSONS

PART II

BY
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PREFACE

In no field of human activity has greater progress been made during recent years than in hygiene and sanitation. While the advance must always be led by a small but zealous group of workers, an accurate and up-to-date knowledge of the elementary facts of these two subjects should be the common property of all the people. It is the purpose of "Practical Health Lessons" to present to pupils in the grammar grades of the elementary schools, in clear and simple language, all the essential facts of personal hygiene and as much of public hygiene as every citizen ought to know.

Health instruction is effective only as it leads the pupil to live in accordance with the laws of health. The average grammar grade pupil will pay little heed to laws for which he sees no reason. The reasons for these laws are found partly in the structure of the body, but chiefly in the way the body works and in the nature of the external dangers to which it is exposed. To care for one's health intelligently, some knowledge of anatomy and physiology is absolutely necessary. So much—and no more—these books aim to give. What is especially emphasized throughout is *the right way to live*, but the *reason* for this way is always made clear. The subject of disease germs and the prevention of communicable diseases is treated fully and is presented in such a way that it will be easily comprehended by pupils of the lowest grammar grades.

For the purpose of arousing and stimulating his interest in the subject and of making the teaching more effective, an effort has been made, wherever it seemed possible, to draw on the pupil's own observation and experience in developing the reasons for the health laws which he must learn. While these laws are stated as positively and emphatically as possible, special pains have been taken to avoid dogmatic and unqualified statements which may be contradicted by the pupil's own experience.

There is an unfortunate tendency to make health instruction merely a matter for supplementary reading. Both the teacher and the pupil should realize that hygiene is a subject of vital importance, and that the preservation of one's health is a matter that deserves the most careful and earnest study. These "Health Lessons" are not intended for casual reading. They are to be *studied*, and it is confidently believed that they contain nothing that is not worth serious study.

CONTENTS—PART II

CHAPTER PAGE

I. RESPIRATION—BREATHING.................... 9

II. TUBERCULOSIS AND OTHER INFECTIOUS DISEASES.. 32

III. THE SKIN AND THE KIDNEYS.................. 43

IV. DIET AND COOKING.......................... 58

V. WATER SUPPLY............................. 87

VI. THE NERVOUS SYSTEM........................ 98

VII. THE SPECIAL SENSES........................128

VIII. EMERGENCIES...............................149

IX. PUBLIC HYGIENE............................163

HEALTH LESSONS

PART II

CHAPTER I

RESPIRATION—BREATHING

1. Purpose of Respiration.—All animal life is maintained by *oxidation*, that is, by *burning up* in our bodies the nourishing parts of the food we eat. Of course, there is really no flame or smoke, but the process is similar, and the warmth of our bodies is produced by these internal fires. To keep up this process of oxidation, all parts of the body must be supplied with *oxygen*. The oxygen which the body needs is obtained from the air we breathe, and it is carried from the lungs to all parts of the body by the blood.

Wherever oxidation is going on, a gas called carbon dioxide is produced. This is a form of waste matter which is injurious to the body. It is carried away from the tissues by the blood and is thrown out of the body with the air that is breathed out of the lungs.

The purpose of respiration, or breathing, is to supply oxygen to all parts of the body and to remove part of the waste matter of the body.

2. The Air Passages.—To reach the lungs, the air passes through the nostrils, the pharynx, the trachea or windpipe, the bronchi, and the bronchial tubes.

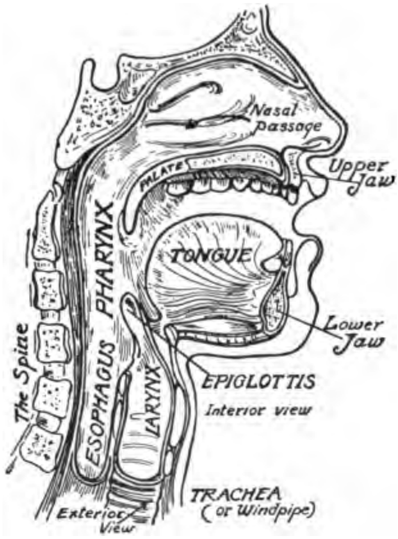

Fig. 1.—The air passages.

The *nostrils* are lined with a thin, pink membrane, which is always moist so that it may catch and hold any dust that is in the air. The nostrils also contain small hairs which keep out the dust. In each nostril there are masses of soft, spongy tissue which is very rich in blood-vessels. These warm the air as it passes through the nose on its way to the lungs, and also supply it with a little moisture when it is too dry. When we have a "cold in the head," these masses of tissue become so swollen that the nostrils are entirely closed, and it is impossible to breathe through the nose.

From the nostrils the air goes to the *pharynx*. This is the open space in the upper part of the throat, back of the mouth and the nose (Fig. 1). It opens below into the esophagus and the larynx.

The *windpipe*, or *trachea*, is about 4 inches long and nearly 1 inch in diameter. It is made up of stiff rings of cartilage or gristle, so that it is always held open for the free passage of air to and from the lungs. The top of the windpipe is larger than the lower part, forming a sort of round box called the *larynx*.

The *esophagus*, or gullet, lies behind the larynx. To keep food and drink from getting into the larynx, there is a spoon-shaped lid of cartilage called the *epiglottis*, which fits down tightly on the larynx when we swallow and opens when we breathe.

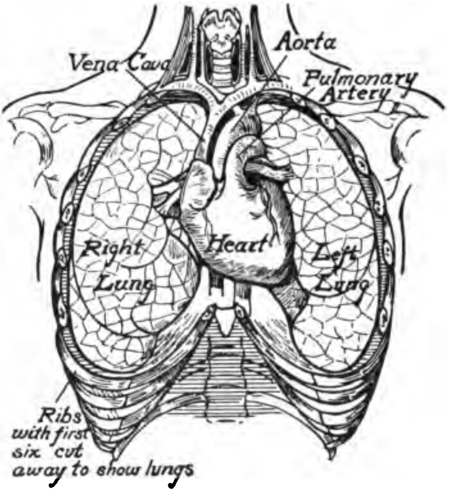

Fig. 2.—The heart and the lungs.

Just behind the upper end of the breast-bone the windpipe divides into two branches (the *bronchi*), one to each lung. Each branch, as it enters the lung, divides into smaller branches called *bronchial tubes*. These reach all parts of the lungs.

3. The Lungs.—The lungs are two large, spongy, pinkish organs that fill almost the whole of the chest (Fig. 2). They are covered with a membrane called the *pleura*.

In the lungs the bronchial tubes divide into smaller and smaller branches, like the limbs of a tree. Each tiny tube ends at last in a cluster of little air-sacs. Each air-sac is surrounded by a network of blood capillaries. The walls of the air-sacs and of the capillaries are so thin that both oxygen and carbon dioxide can easily pass through them. There are millions of these air-sacs in the lungs.

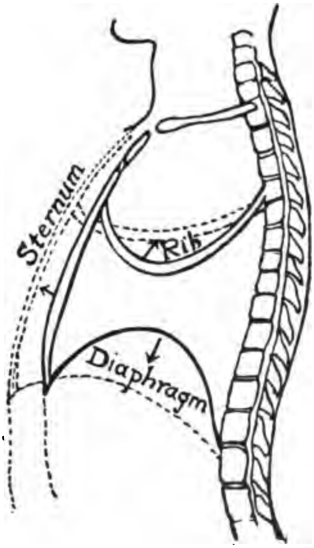

Fig. 3.—How we breathe.

4. How We Breathe.—The trunk contains two cavities, the chest, or thorax, and the abdomen. These are separated from each other by a muscular partition called the *diaphragm*, which is attached to the backbone and the lower ribs. The diaphragm is not flat; it rises in the middle, like a dome (Fig. 3). The sides of the chest are formed by the ribs. These bones do not pass straight around the chest from front to back. They curve downward as well as outward. Fastened to the ribs are strong muscles.

When these contract, they draw the ribs upward and outward.

There are two different acts in breathing—taking air into the lungs, or inspiration, and forcing air out of the lungs, or expiration. In inspiration, the diaphragm contracts and becomes flatter, the ribs are drawn upward and outward, and the breast-bone is pushed forward. You can easily feel these movements by placing your hands firmly on the chest when you take a deep breath. By these movements, all the dimensions of the chest are increased. It becomes larger from above downward, from side to side, and from front to back. To fill this increased space, the air rushes in and expands the lungs. In expiration, the diaphragm curves upward again, the ribs drop downward and inward, and the breast-bone moves backward. The size of the chest is reduced, and part of the air in the lungs is forced out.

The ribs and diaphragm together make a sort of bellows of the chest, by which air is drawn into the lungs and forced out of them. In ordinary breathing, we take about eighteen or twenty breaths every minute, or one breath for every four beats of the heart.

If we force out as much of the air in the lungs as we can and then take a deep breath, we take into our lungs about 4 quarts, or 230 cubic inches, of air. The chest will expand from 4 to 5 inches. In ordinary breathing, about 1 pint (30 cubic inches) of air is taken into the lungs at each breath. Put a tape-line around your chest, and see how many inches your chest expands when you take a deep breath. If you will practice deep breathing, your chest will expand more and more, and your lungs will become larger and stronger.

5. How the Air and the Blood are Changed in the Lungs.—The air that we breathe is a mixture of two gases, oxygen and nitrogen. About four-fifths, or 80 per cent., of the air is nitrogen, and one-fifth, or 20 per cent., is oxygen.

In the lungs, the air loses about one-fourth of its oxygen. The oxygen is taken up by the red corpuscles of the blood and is carried to all parts of the body. It combines with the carbon of the tissues to produce heat and power. When this occurs, a new gas is formed which is called carbon dioxide. This is one of the waste products of the body. It is carried away by the blood. When the blood reaches the lungs, it gives up its carbon dioxide in exchange for a fresh supply of oxygen.

In the lungs, the air loses oxygen and takes up carbon dioxide. The blood gives up carbon dioxide and takes up oxygen. There is a change in the color of the blood. When it comes to the lungs, it is bluish-red or purple in color. When it takes up a new supply of oxygen, its color changes to a bright red.

The air also takes up a small amount of water from the blood. If you breathe on a cold mirror or a pane of glass, you can see the moisture that collects on it from your breath.

6. The Voice.—The top of the trachea, or windpipe, is larger than the lower part, forming a sort of round box of cartilage or gristle. This is called the *larynx*. Stretched across the larynx from front to back are two thin membranes called the *vocal cords*. The sounds of the voice are produced by the vocal cords.

In ordinary breathing, the space between the cords is wide open. In speaking or singing, the cords are stretched tight, leaving only a narrow space between them. As the air is forced through this narrow opening, the vocal cords vibrate and produce a sound. In singing, the tones depend upon the length of the cords and upon how tightly they are stretched. Low tones are produced by long cords and cords that are not tightly stretched; high tones, by short, tightly stretched cords. In women and in children the larynx is smaller and the vocal cords are shorter than in men. This is the reason their voices are higher. The sounds used in speaking are formed partly by the vocal cords and partly by the tongue, the teeth, and the lips.

7. Correct Breathing.—In correct breathing, both the ribs and the diaphragm are used, and air is drawn into all parts of the lungs. This is often called "deep breathing." Women who wear their clothing very tight about the waist can use only the upper ribs in breathing. Their breathing is shallow. Only part of the lungs is supplied with fresh air. Men who sit all day at their work often use the ribs very little in breathing. The diaphragm does most of the work. In this case also only part of the lungs is used. To breathe deeply and correctly, both the diaphragm and the ribs must move freely.

To strengthen the lungs and to get fresh, pure air into every part of them, we should every now and then take a few deep breaths, inhaling as much air as the lungs will hold and then forcing out as much of it as we can. It is best to do this in the open air. By doing it regularly, the size of the chest and the capacity of the lungs may be increased considerably, and we will be much less likely to get diseases of the lungs.

We should always breathe through the nose, never through the mouth; and we should train ourselves to do this, even when we are working hard or exercising. This is especially important in cold weather. The nose warms the air as it passes through it on its way to the lungs. It catches and holds the dust in the air. Through the sense of smell it also warns us against bad air.

8. Adenoids.—Some children cannot breathe through the nose at all, because the back of the nostrils is filled with a spongy growth which entirely blocks the passage. These growths are called *adenoids* (Fig. 4). Children who suffer from them can nearly always be recognized by their open mouths and dull faces. They do not grow and develop as healthy children do. They are flat-chested and stoop-shouldered. They are always catching cold and are much more likely than other children to catch all kinds of contagious diseases. Adenoids are a common cause of deafness. Children who have adenoids are nearly always dull pupils at school.

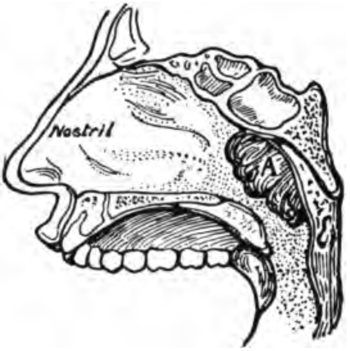

Fig. 4.—Section through nose: *A*, Adenoids.

Adenoids can be removed by the surgeon. The operation is not dangerous. It is important that this should be done as early as possible, before the mind is permanently injured. Children who are "mouth-breathers" should be examined by a physician to find out if they have adenoids.

9. Effect of Tight Clothing on Breathing.—To provide a sufficient supply of oxygen for the body, every part of the lungs should be used. When clothing is worn tight about the waist, only part of the lungs can expand. The body does not get enough oxygen. The lungs are weak and poorly developed, and much more subject to such diseases as pneumonia and consumption. The fire in the stove will not burn well without a good draft. The fires in our bodies, by which life is maintained, cannot burn well without plenty of oxygen. It is just as impossible to live well without good lungs as it is for a fire to burn well without a good draft. Tight clothing about the waist shuts off the draft by which the fires in the body are kept going.

10. Causes of Impure Air.—The air that we breathe out of our lungs is impure. It has lost part of its oxygen and has had carbon dioxide and other impurities mixed with it. There are many other ways in which air is made impure. A great deal of waste matter is thrown off through the skin, and much of this is taken up by the air. All warm-blooded animals are constantly taking oxygen out of the air and filling the air with waste matter given off by the skin and the lungs. In many school-rooms the unclean bodies of some pupils and the dirty clothing of others help to make the air foul. Such air has a disagreeable odor that we recognize at once on coming into the room.

Wherever there is any fire or flame, oxygen is being used up and carbon dioxide is being produced. A single oil lamp or gas light burns up more oxygen than a person uses up in breathing. Electric lights, however, do not make the air impure. All fires consume enormous amounts of oxygen. They often fill the air with injurious gases. Coal stoves may be very dangerous, as they sometimes give off a poisonous gas which, in a tightly closed room, will soon kill any one who breathes it. The air near factories is often made very impure by gases and smoke. Smoke and gases should be discharged into the air through a stack or chimney tall enough to avoid spoiling the air of the neighborhood.

Decaying animal and vegetable matter is a frequent source of impure air, especially about country homes. Stables and barn-yards should be kept clean, and manure piles should not be placed near dwellings. Garbage and other waste should be kept in tightly closed cans until it can be removed. In cities, defective drains may allow injurious gases from sewers to enter the house.

Out of doors, the most common impurities in the air are dust and the germs that are carried by dust. This is especially true in cities. A great deal of this can be prevented by sprinkling the streets and sweeping them daily. On country roads, the use of oil will do away with dust.

11. Effects of Impure Air on Health.—Breathing impure air, even for a short time, makes us dull and drowsy. It often causes dizziness, headache, and nausea, and may even cause vomiting. People who spend most of their time indoors and who are always breathing impure air usually look pale and sickly. The body does not get enough oxygen. The blood is pale and poor. The poisonous gases that are breathed over and over again weaken the body so that it is not able to resist disease. These persons are very likely to die of some sickness from which they might have recovered if they had always had plenty of fresh air.

12. How Air is Purified.—It is interesting to learn what becomes of all the carbon dioxide that is produced, and how the oxygen of the air is renewed.

Carbon dioxide is a combination of carbon and oxygen. When a piece of wood is burned, it is not really destroyed, it simply *changes its form* and becomes ashes and gas. The carbon in the wood unites with the oxygen of the air, forming carbon dioxide. The lime and other minerals remain in the form of ash. Other substances disappear in the form of gas. Nothing is really destroyed. It changes its form and most of it becomes carbon dioxide.

It is the same with the carbon dioxide that is produced in the body. The oxygen which the blood takes out of the air is not destroyed; it unites with the carbon in our bodies and forms carbon dioxide. The oxygen is all there, but the body cannot use it again because it is so closely combined or tied up with the carbon.

Now it happens that plants need carbon as badly as animals need oxygen; and they have the power to break up the combination of carbon and oxygen in carbon dioxide. Plants take carbon dioxide out of the air. The carbon they use; the oxygen is set free and is given back to the air. This process is especially rapid under the influence of sunlight. Trees and lawns not only beautify our cities, but they are very useful in purifying the air as well. It is well to remember, however, that at night plants give off a certain amount of carbon dioxide themselves. It is not wise to keep plants in the sleeping room.

13. Ventilation.—The air that is breathed out of our lungs is not fit to be breathed again. It has lost about one-fourth of its oxygen. If we had to breathe this same air again and again, we would die in a very short time, because the blood could not get enough oxygen to keep the body alive. Besides losing oxygen, the air that leaves the lungs has had poisonous waste matter mixed with it. When a number of people stay in a tightly closed room, the air soon loses so much of its oxygen and becomes so foul with waste matter that it is dangerous to those who breathe it. It may even kill those who must stay in the room.

The story of the famous "Black Hole" of Calcutta shows how dangerous such air may become. In 1857, during a rebellion in India, 146 English prisoners were confined in a small room 20 feet square, with only two small windows to admit fresh air. After eight hours only 23 of them were alive. Nearly all of the survivors died in a short time of a fever that broke out among them. After the battle of Austerlitz, in 1805, 300 captives were crowded into a small prison; and 260 of them died in a short time for want of fresh air.

If a man were accidentally locked up in an air-tight box or closet, he would die in an hour or two unless some one opened the door to give him fresh air. Even staying in a large room without fresh air causes dulness, drowsiness, and headache. To avoid these things, our rooms must be *ventilated.* Ventilation means bringing fresh air into a room to take the place of impure air. There are not many ways in which we neglect our health so much as in the matter of fresh air and sunshine. Few of us realize how important these things are. One reason for this is that the effects of bad air usually come on so slowly that they are not recognized. People live for years in dark, poorly ventilated rooms, their bodies always starving for sunshine and oxygen, and yet they never suspect that this is the cause of their poor health. Wild animals never suffer from tuberculosis while they live in the open air. When they are captured and kept indoors, they nearly all die of it. If they are kept in cages in the open air, they escape the disease. It is only when they are deprived of fresh air and sunshine that they become subject to it. Exactly the same thing is true of human beings. Thousands of people die every year whose lives might be saved by sunshine and fresh air.

We have been particularly negligent in this matter in the very places where it is most important—in our schools, churches, theaters, and public halls; for the more people there are in a room, the more necessary it is to have a large and constant supply of fresh air.

It frequently is bad air that makes the sermon seem dull, and not a poor preacher. Often it is want of fresh air that makes pupils dull and inattentive at school.

14. Amount of Air and Air-space Needed.—In ordinary breathing, we take about 30 cubic inches (about 1 pint) of air into our lungs at each breath. When this air is breathed out of our lungs, it contains so much carbon dioxide and other waste matter that it will spoil about 2½ cubic feet (about 2 bushels) of air and make it unfit to breathe. Breathing twenty times a minute, each person in a room will spoil 50 cubic feet of air every minute or 3000 cubic feet every hour. To keep the air in a room fit to breathe, each person in the room must be supplied with 3000 cubic feet of fresh air every hour.

In small rooms there should be not less than 500 cubic feet of space for each person, and all the air in the room should be completely changed six times every hour. If the air is changed more frequently than six times an hour in a small room, dangerous drafts are produced. In large rooms, the air can safely be changed as often as ten or twelve times an hour. In this case 250 to 300 cubic feet of air-space for each person is sufficient; but we must be sure that all the air in the room is changed every five or six minutes, or ten to twelve times an hour. This may easily be tested by filling the room with smoke, and then noting the time it takes to clear the air with all the ventilators open.

Children do not need as many cubic feet of fresh air every hour as do adults; 2000 cubic feet are usually considered enough. If the air of a school-room can be completely changed ten times an hour, the quantity of air-space needed for each pupil is about 200 cubic feet.

15. How to Ventilate.—During the warm season of the year, when doors and windows can be opened wide, it usually is easy enough to get plenty of fresh air. Any room that cannot be aired fairly well by opening the doors and windows is not fit to live in. When it is not too cold, we should keep our windows open as much as possible. They should be opened at the top as well as at the bottom, to allow the air to circulate freely and to keep the air of the whole room fresh and pure. The windows should be screened to keep out flies, because flies carry disease germs.

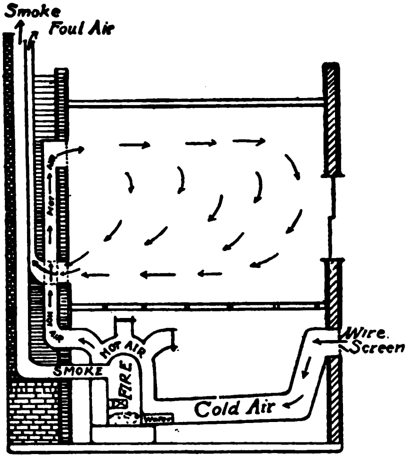

Fig. 5.—Ventilation with hot-air heater.

During the winter months, when our rooms must be heated, it is often difficult to get plenty of fresh air; and many people suffer from breathing impure air. To secure good ventilation, two things are necessary: first, some way to bring pure air into the room; and, second, some way to get rid of the foul air. The best ways of doing this depend upon how the house is heated.

The open fire-place is one of the best ways of getting rid of bad air. Rooms heated in this way are usually well ventilated, but it is a wasteful and unsatisfactory way of heating.

If a hot-air heater is used, there should be an air-duct to bring *fresh air* to the heater *from outside the house.* In many homes the old-fashioned hot-air heater simply takes the foul cellar air, warms it up and sends it up into the living-rooms. Such air cannot be fit to breathe. If pure air is brought to the heater from the outside, the warm air that comes from the heater will be pure; and all that is necessary is to provide a way for the foul air to escape. This may be done by opening the window for an inch or two, or by a special ventilating flue, as shown in the drawing on p. 24. Here the heat of the smoke flue causes a draft in the ventilating flue which helps to draw the foul air out of the room.

With ordinary stoves, hot-water heat, and steam heat the air is *warmed in the room.* It is best, in this case, to have the fresh air brought into each room through an air-duct that opens under or near the stove or radiator. The air is heated as it rises around the radiator or stove. The upper sash of the window may be used as an outlet for the impure air, or special outlets may be provided.

If there are ventilating flues to carry off the foul air, the openings into these flues should be from that part of the room where the air is most impure. This will be either near the ceiling or near the floor, depending upon the way the room is heated. If the air is heated *before* it is brought into the room, it will become cooler and *heavier* after it enters. The air will be most impure near the floor. If the fresh air is *cold* when it enters the room, and is *heated in the room,* then the "oldest," warmest, and most impure air will be found near the ceiling. If the fresh air is heated *before* it enters the room, it should be brought in through an opening near the ceiling, and the outlet for the foul air should be near the floor. If the fresh air is *heated in the room,* the outlet for the foul air should be near the ceiling.

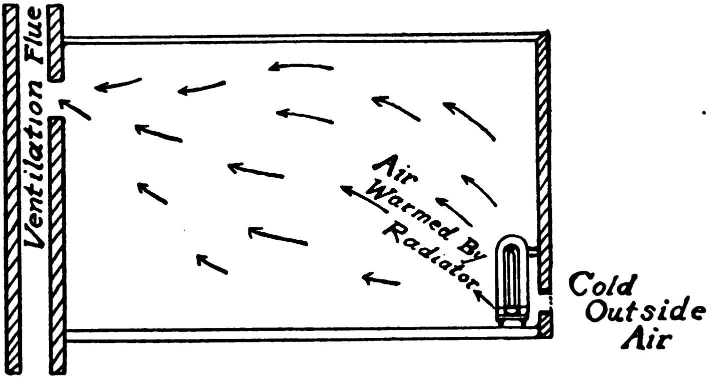

Fig. 6.—Ventilation with radiator.

Oil stoves and gas stoves should never be used to heat living-rooms or bedrooms. They use up enormous quantities of oxygen, and they fill the room with injurious gases. It is impossible to keep the air pure in a room that is heated with an oil stove or a gas stove.

When only a few people occupy a room, enough fresh air can usually be obtained by raising the lower sash of the window and placing a board under it. The fresh air comes in through the space between the upper and the lower sash, and blows upward as it enters the room. A more abundant supply of fresh air is obtained by raising the lower sash a few inches and placing a slanting board or a sheet of glass inside the window, so that the cold air will not blow over the people in the room. Or a small screen, like a fly screen but covered with thin cloth instead of netting, placed under the lower sash, will allow air to enter the room without causing a draft.

16. Flushing Crowded Rooms.—If a room is occupied by a large number of people, it is necessary to open all the doors and windows for a few minutes every hour, or several times an hour, so that all the foul air in the room may be thoroughly "flushed out." Even in cold winter weather, the room will usually become comfortably warm in a few minutes, because the walls retain their heat. Those who use the room should leave it when this is done or should go through some brisk exercises and, if necessary, put on their wraps. It is worth some trouble to get plenty of fresh air.

17. Ventilating the Bedroom.—It is just as important to have pure, fresh air in the bedroom as in the living-room. Most of us spend about one-third of our time in our sleeping-rooms. To keep the windows tightly closed and to breathe the same air over and over again makes us feel tired and dull in the morning, causes headache, weakens the lungs, and makes us liable to consumption. We can nearly always get plenty of fresh air by opening the windows. It is not necessary to have bedrooms as warm as living-rooms. A cool room is much healthier if one has plenty of warm covers. There is an old-fashioned notion that it is bad to breathe night air. People once thought that night air caused malaria. The reason for this was that the mosquito, which causes malaria, usually flies at night. If our windows are screened to keep out mosquitoes, and if we are careful to avoid drafts, we need never fear the night air.

18. Keeping Air Moist.—During the winter, when the air in our rooms is heated, it is apt to become very dry. This hot, dry air has an injurious effect upon the delicate membrane which lines the air passages. The nose and throat become dry and parched, and when we go out into the open air we are much more likely to catch cold or pneumonia. These bad effects may be avoided by adding moisture to the heated air. Hot-air heaters often have water pans in the space where the air is heated, and these pans should always be kept filled. Hot-water and steam heat are most likely to make the air excessively dry. The air-valve on steam radiators may be left open slightly, allowing enough steam to escape to keep the air moist. A pan of water placed on the radiator will usually supply enough moisture.

19. Temperature of Living-rooms.—Many houses are kept too hot in winter. The body cannot adjust itself to such great changes of temperature as one often finds on going from a warm living-room to the outside air. Staying in overheated rooms is a very common cause of colds. Living-rooms need never be heated above 70° F. If the air is kept sufficiently moist, a temperature of 65° to 68° F. will usually be found comfortable.

20. Care of the Vocal Organs.—The vocal cords are very sensitive. When anything irritates them, they become swollen and painful; and the voice becomes hoarse. This is often caused by improper use of the voice. The vocal cords are strained by "forcing" the voice, shouting, or singing too loud. In speaking and singing, one should keep the mouth opened well, avoid harsh sounds, and put as little strain on the vocal cords as possible. Both alcohol and tobacco irritate the throat and the vocal cords. Cigarette smoking is particularly injurious. Colds are a common cause of hoarseness. Bathing the neck with cold water is one of the best ways to avoid catching cold.

21. Effect of Alcohol and Tobacco on the Lungs.—When alcohol is taken into the stomach, it is absorbed very quickly. The body tries to get rid of it as soon as possible. Much of it is thrown off through the lungs, as you can easily tell by the breath of the man who has been drinking. Lung tissue is very delicate, and alcohol has a very injurious effect on it. Persons who use alcoholic liquors are much more likely to have pneumonia and consumption than if they did not use strong drink; and they are much more likely to die of these diseases than people who do not use liquor.

Tobacco smoke irritates the lining of the throat. Those who use tobacco regularly often have a husky voice, due to the effect of tobacco on the vocal cords. The excessive use of tobacco may even cause cancer of the throat. The use of cigarettes is particularly injurious to the lungs, because the smoke is usually inhaled. It has been proved that those who use tobacco regularly cannot take as much air into their lungs as those who do not use it.

Opium has a depressing effect upon respiration. When it is taken in poisonous doses, respiration becomes very slow and finally stops altogether. Opium kills by stopping the breathing.

QUESTIONS

Explain clearly the purpose of respiration.
Name the air passages and describe each briefly.
Describe the lungs.
Explain how we breathe.

Tell how the air and the blood are changed in the lungs.

Tell how the voice is produced.

Describe the correct way of breathing. Name some incorrect ways of breathing and tell why each is bad.

What are adenoids? What are their effects on children?

Tell how clothing may interfere with correct breathing.

What things make air impure? What is the effect of breathing impure air?

Explain how carbon dioxide is taken out of the air.

What is ventilation? Explain when and why it is necessary.

If the air in a room can be changed eight times an hour, how many cubic feet of space must be allowed for each person in the room? Explain fully.

What two things must be provided for in ventilating a room? Show how ventilation is related to heating. Describe fully several good ways of ventilating.

What is meant by "flushing" a crowded room? Have you ever tried it? Did you notice any change in your feelings?

Why should bedrooms be ventilated? How can they be ventilated?

What are the bad effects of hot, dry air? How can they be avoided?

At what temperature should living-rooms be kept?

Tell how to care for the vocal organs.

What is the effect of alcohol on the lungs? Of tobacco? Of opium?

CHAPTER II

TUBERCULOSIS AND OTHER INFECTIOUS DISEASES

22. Prevalence of Tuberculosis.—"Tuberculosis is one of the most dreadful and, unfortunately, one of the most common diseases. . . . It is the most common cause of death among human beings, and is common among animals, occurring with great frequency among cattle, less frequently among goats and hogs, and sometimes, though rarely, among sheep, horses, dogs, and cats. Wild animals escape the disease, but when caged even the strongest may get it. It is the most common cause of death among captive monkeys. It occurs in birds, and even in reptiles and fishes."*

In the United States about 150,000 persons die of this disease every year, more than 400 every day. Every three minutes some one dies in this country of tuberculosis. Not only does it *kill* more people than any other disease, but it is one of the most common causes of deformity because it so frequently attacks the bones and the joints of children.

23. Cause of Tuberculosis.—Tuberculosis is caused by a germ called the *tubercle bacillus* (Bacillus tuberculosis—Fig. 7). It was long believed that tuberculosis was a hereditary disease; that is, that children inherited it from their parents; but it is very rare for a child to be born with the disease. Children of tuberculous parents are likely to get the disease because they are constantly exposed to it and because, as a rule, they have weak constitutions. No one ever gets the disease, however, except by taking the germs into his body in some way.

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* McFarland's Pathogenic Bacteria.

There are so many people who have the disease, and the germs are so widespread, that hardly any one can hope to escape them. All of us get them into our bodies at some time or other. But not all of us get the disease, for the germs cannot produce the disease unless they find conditions favorable for their growth. If we are well and strong, the body can protect itself against the germs. If we are "run down," the germs live and multiply, and we get tuberculosis.

Fig. 7.—Germs of tuberculosis. (Highly magnified.)

24. How Tuberculosis is Acquired.—The germs always come from some person or some animal that has tuberculosis. They are found in the milk and in the flesh of tuberculous cattle, and they may get into our bodies in that way. It is far more common, however, to take the disease directly from some person who has consumption. Such a person may cough up several billions of the germs every day. These are carried for a number of yards in the fine spray that is thrown out in coughing; or the sputum dries and the germs are carried about in the air and inhaled by someone else. This is the usual mode of infection.

The germs of tuberculosis may live for a long time after they have been coughed up by a consumptive. They may be found for months afterward on the carpets and on the walls of the room he used. In tenement houses there are rooms where one person after another gets consumption and dies. Family after family moves in—all in good health. In every family one or more persons get consumption while they live in these rooms. There is no doubt that the germs remain alive in these rooms and dwellings for a long time after people move out, and that people moving in get the disease in this way. One should never move into a house without having it thoroughly disinfected.

25. How Tubercle Bacilli Affect the Body.—When tubercle bacilli get into the lungs or into the small glands of the intestines, where there is warmth, moisture, and nourishment, they begin to grow. Wherever they grow, little rounded lumps or nodules are formed around them. These are made up of white corpuscles and of other cells that have the power to destroy bacteria. These little lumps are called *tubercles*, and the disease gets its name, tuberculosis, from them.

One of two things now happens. If the body is in good condition, the germs are all destroyed; or they are "walled in" by connective tissue so that they can do no harm, and in time they all die. This is how tuberculosis is cured, even after it has had a good start. If the cells are not able to destroy the germs, the germs kill the cells. As the cells die, the tubercle breaks down into a cheesy material like pus. The germs spread on all sides. New tubercles are formed, and break down in the same way, until large masses of tissue have been destroyed. Large holes or cavities are formed in the lungs. Sometimes almost the entire lung is consumed.

In children the bones and joints are very often attacked. In the spinal column parts of the vertebræ are destroyed, causing hump-back. The bacilli invade the joints and cause hip-joint disease, "white swelling" or knee-joint disease, ankle-joint disease, shoulder-joint disease, and so on. Children often suffer from "swollen glands" of the neck, and this is often, though not always, a form of tuberculosis. The intestines, the liver, the kidneys, the heart, and the brain are all subject to tuberculosis. When the germs attack the coverings of the brain and the spinal cord, they cause meningitis.

Tubercle bacilli cause disease both by destroying tissue, as in bones and joints, and by producing toxins or poisons, as in meningitis. Usually, as in consumption, they do both.

26. Early Signs of Consumption.—Tuberculosis of the lungs is an exceedingly dangerous disease, not because it cannot be prevented or cured, but because it comes on so slowly and so quietly that it is not recognized until the patient is too sick to be cured.

When tubercle bacilli lodge in the lungs and begin to grow there, they may give no sign of their presence for months. Perhaps the person feels a little more tired in the evening than usual. His appetite is not quite so good, and he may lose a few pounds in weight. He may have a little pain in the chest now and then, and a slight cough. He may be somewhat feverish and have a rapid pulse in the afternoon. For a long time he may notice no other signs and never suspect that anything is wrong.

A person may have *all* of these things and be entirely free of tuberculosis; but he cannot be sure that he does not have consumption unless he is examined by a physician. This must never be neglected or delayed. In the early stages the disease is curable. In the later stages nothing can be done—the case is hopeless.

As the disease progresses, the appetite becomes poorer and the patient loses weight rapidly. His cough gets worse. His sputum contains pus and blood. He has fever and night-sweats. All these things continue to grow worse, he gets weaker and weaker, and finally dies.

There are two important facts to be remembered about consumption—first, that it can be prevented; second, that it can be cured if it is quickly recognized and promptly treated.

27. How to Prevent Consumption.—The sputum of consumptives is the great source of danger. If this were always thoroughly destroyed, there would be few new cases. Consumptives should use spit-cups of paper or metal. It is not safe to use cloths instead; the sputum gets on the clothing and on the hands, and is sure to be carried to other persons. Paper spit-cups should be burned, with their contents. In metal cups, a solution containing 5 per cent of carbolic acid should be used to kill the germs, and the cups should be washed in boiling water. Spitting on sidewalks, in street cars, and in other public places should be forbidden by law. This filthy practice causes thousands of deaths every year.

It is not safe to stay in a closed room with a consumptive for a number of hours every day. Children with tuberculosis of the lungs should not attend school unless they can be placed in an "open-air" class.

The consumptive should have his own room, which must be well ventilated. He should hold a cloth before his face when he coughs or sneezes, and this cloth should be burned. His clothing should be handled as little as possible by others, and should be boiled when it is washed. Rooms that have been occupied by consumptives should be thoroughly cleaned and disinfected before they are used by any one else. When a person is known to have consumption, the danger of spreading the disease should be kept in mind constantly, and every effort should be made to avoid carrying the germs to someone else.

28. How Consumption is Cured.—Two things only are necessary to cure any case of consumption that is still curable—*fresh air* and *plenty of good food.* Patent medicines that are advertised as cures for consumption are all frauds. There is no medicine that will cure the disease, and most of them make it worse.

Plenty of fresh air, day and night, and nourishing food that is easily digested, like milk and raw eggs, will cure most of the cases in the early stages of the disease. It is necessary to begin the treatment *early.* In the later stages nothing can be done that will cure the disease. If a cough lasts more than three weeks, a physician should be consulted, especially if there is pain in the chest, loss of appetite, and fever. These are danger signals that must be heeded promptly. Even a month's delay may make the case hopeless.

Many states have built sanitariums for the treatment of consumption. A change of climate is often beneficial. It is an advantage to have a clear, dry atmosphere, where one can get the greatest possible amount of sunshine. These things help, if one can afford them; but they are not absolutely necessary.

Nearly every curable case will get well at home if the patient will do exactly as the doctor directs. The reason more people recover in sanitariums is that they are compelled to carry out the doctor's orders. In many cases people who have been cured in a sanitarium soon fall victims to the disease again when they return to their homes and resume their old, careless way of living.

29. How to Avoid Consumption.—Consumption can be cured if it is taken in time; but "an ounce of prevention is worth a pound of cure." Prevention is not impossible; usually it is not difficult. Avoid close contact with consumptives. Breathe pure, fresh air day and night. Get all the sunlight you can. Eat nourishing food. Exercise in the open air. Keep the body clean. These are the things that make it possible to avoid consumption.

Remember that consumption is peculiarly a house disease, a disease of infected rooms, of rooms that lack fresh air and sunlight. People who work outdoors and who keep their windows open at night rarely get it. Wild animals never suffer from it. It is indoor life, with its want of sunlight and fresh air, together with constant association with consumptives, that breeds tuberculosis, the "great white plague," which is killing 150,000 of our people every year.

30. Diphtheria.—This disease is most common among children, but it sometimes attacks grown persons. It is sometimes called "membranous croup," because the germs cause a grayish membrane to form in the throat. It usually begins with sore throat, chills, and fever. Some cases are so mild that they are not recognized as diphtheria, and these children give it to others. Children should be warned not to exchange whistles, candy, chewing gum, drinking cups, or anything else that is put into the mouth. The germs are often spread in this way.

The patient should be isolated and antitoxin should be given as soon as possible. All who have been exposed should receive an immunizing dose of antitoxin. Strict quarantine must be maintained until the germs have all disappeared from the throat.

31. Scarlet Fever.—Scarlet fever is a disease of children. Adults are rarely attacked. It begins with sore throat, vomiting, high fever, and a very rapid pulse. On the second day a bright *scarlet* rash appears on the neck and chest and spreads over the entire body. After the rash disappears, the outer layer of the skin peels off either in large flakes or in tiny scales. This may continue for two to eight weeks.

The disease is highly contagious. Strict quarantine is necessary from the time the first symptoms appear until the peeling of the skin has stopped entirely. The sick room and everything used by the patient must be thoroughly disinfected. The disease may be acquired from infected clothing months after the patient has recovered.

32. Measles.—Measles begins as a bad cold. The rash comes out on the fourth day. The scarf skin is shed in small flakes as the rash fades out. The disease is very contagious.

Parents sometimes purposely expose their children to measles with the idea that they are sure to get it anyhow, and that it is best to have it over at once. This is a wicked practice. Measles is not always a mild disease. It kills more than 10,000 children in the United States every year. A great many more die of pneumonia, which often follows measles in children.

Children who have measles should be quarantined for at least three weeks, and their clothing and the room should be disinfected.

33. Whooping-cough.—Whooping-cough may attack adults, but usually occurs in children. Those who have it require plenty of fresh air and often do best outdoors; but they must be kept away from other children for at least five weeks or until the cough ceases. This may be several months.

34. Mumps and Chicken-pox.—These are common diseases of children, but are less serious than those already named. In mumps there is a painful swelling of the parotid gland, below the ear and behind the jaw. In chicken-pox there is a skin eruption which forms little blisters. These dry up in a few days, leaving thin, black crusts. In both diseases, patients should be isolated and the room disinfected after they recover.

QUESTIONS

Give some facts showing how common tuberculosis is.

Why do the children of tuberculous parents so often get the disease?

Explain clearly *how* people get tuberculosis.

What happens when tubercle bacilli begin to grow in the lungs?

What other parts of the body are often affected?

Describe the early signs of consumption. Why is it important to know these signs?

Explain fully how consumption can be prevented.

How is consumption cured?

What can each of us do to avoid consumption?

What are the early signs of diphtheria? What should be done when a child has this disease?

What are the early signs of scarlet fever? What precautions are necessary in scarlet fever?

How does measles begin? Do you think it is right to expose a child to this disease purposely?

What care should be taken when a child has whooping-cough?

What signs would make you think of mumps? Of chicken-pox?

CHAPTER III

THE SKIN AND THE KIDNEYS

35. Meaning and Importance of Excretion.—The body must have *carbon* foods (carbohydrates and fats) to furnish heat and power, and it must have *protein* foods, such as eggs, milk, and meat, to build up and repair the tissues of the body. Both kinds of food, when they are used up in the body, leave *waste matter* which must be removed from the body if we are to keep well. These waste matters are being produced constantly in all the tissues of the body, but chiefly in the muscles and the glands. They are carried away from the tissues by the blood. The same fluid which brings nourishment to the tissues carries away their waste products. The blood carries these waste matters to those organs whose duty it is to get rid of them, to *excrete* them.

The chief waste product of starchy and fatty foods is carbon dioxide, a gas which is thrown off through the lungs. The chief waste product of protein foods is urea, a solid substance, which is dissolved in water and excreted by the skin and the kidneys, chiefly by the kidneys. The lungs, the skin, and the kidneys are the principal *organs of excretion.*

If waste matters are not excreted promptly, they act as poisons. A great deal of ill health is caused by waste matter which is not removed from the body promptly. The work of the skin and the kidneys in getting rid of urea is especially important. If both the skin and the kidneys stop working, death is sure to follow in a few days.

36. Structure of the Skin.—The skin consists of two layers. The outer layer is called the *epidermis*, the cuticle, or the scarf skin. The inner layer is the *dermis*, the cutis, or the true skin (Fig. 8).

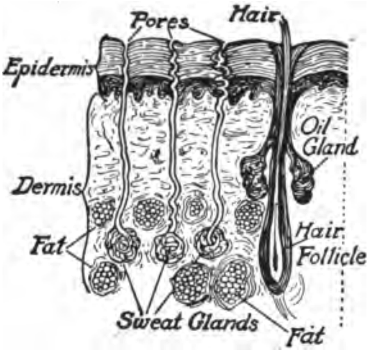

Fig. 8.—Structure of the skin.

The dermis, or true skin, is full of nerves and capillaries. The ends of the nerves of touch are found in the dermis.

The epidermis is made up of rather hard, dry cells, the outer layers being quite horny and flat, somewhat like tiny scales. These dry cells are always being shed from the surface of the skin, and are replaced by cells from the lower layers, which likewise become dry and flat as they come to the surface. The epidermis has no blood-vessels or nerves. It is the part of the skin that is raised in a blister. The tender skin beneath the blister is the dermis, or true skin.

The epidermis protects the delicate nerve-ends and blood-vessels of the dermis. It also helps to keep disease germs and poisons out of the body. Where the epidermis is constantly rubbed or pressed upon, it grows very hard and thick, as on the palms of the laborer's hands and on the soles of the boy who runs barefoot in summer. Corns are thickenings of the epidermis caused by the pressure of shoes that do not fit properly.

The deeper layers of the epidermis contain a *pigment,* or coloring matter, on which the color of the skin depends. This pigment is more abundant in some people than in others. The color of the negro's skin is due to the large amount of pigment which it contains. The complexion of white people depends upon the amount of pigment in the skin.

37. Hair and Nails.—The hair and the nails are really different forms of the epidermis. The hair is made up of pigmented, horny cells, the outer layers arranged like scales. Each hair grows from a little pit in the skin called a *hair follicle.* There are no hairs on the palm of the hand or the sole of the foot. On the scalp the hair is much longer and thicker than on the rest of the body. This helps to break the force of blows on the head.

For each hair follicle there is a small gland which secretes an oily fluid that is poured into the follicle at the root of the hair. This oil keeps the hair and the skin soft and pliable. The glands are called oil glands.

The purpose of the nails is to protect the ends of the fingers and toes. The finger-nails aid us in picking up small objects, in untying knots, and in many other ways. If properly cared for they add very much to the beauty of the hand.

38. The Sweat Glands.—If you examine closely the skin on the palm of your hand, you will notice that it is not perfectly flat and smooth, but that it is covered with tiny ridges. If you look at these through a magnifying glass, you see in each ridge a row of tiny little holes. These holes or *pores* are the open ends of little tubes that run down through the epidermis and end in little coils deep in the dermis. The little coils are the *sweat glands*. In the entire skin there are about 2,000,000 of them.

The sweat glands send out a fluid called perspiration, or sweat. It consists of water and waste matter which the sweat glands remove from the blood. Even in cold weather the sweat glands are constantly excreting this fluid, although we are not conscious of it because the quantity is small and it evaporates at once. This is called insensible perspiration. When it is very warm and when we exercise vigorously, the perspiration is poured out so fast that it collects on the skin in drops. The uses of the sweat are to carry off part of the waste matter of the body and to regulate the temperature of the body.

39. How the Temperature of the Body is Regulated.—When the body becomes too warm, the blood-vessels in the skin dilate, and more blood is drawn to the surface of the body. The sweat glands work much faster, the pores of the skin are wide open, and the skin is bathed in perspiration. The evaporation of this moisture causes the body to lose its surplus heat and keeps the temperature from rising.

When the body becomes too cold, the blood-vessels of the skin contract, there is less blood in the skin, perspiration is diminished, and less heat is lost through the skin.

If the body is suddenly chilled when we are very warm, the blood is driven from the surface of the body to the internal organs, and the perspiration is completely checked. The internal organs all suffer from congestion, that is, they are swollen with an excessive amount of blood. The lungs, the kidneys, and the stomach suffer most. Pneumonia, kidney disease, and indigestion often follow sudden chilling of the skin.

As long as we are well, the temperature of the body is always just $98\frac{3}{5}$° F. In many diseases the tissues of the body are burned up so rapidly that much more heat is produced than is needed. At the same time the sweat glands work very slowly, so that the body cannot get rid of the extra heat. The temperature rises above $98\frac{3}{5}$° F., sometimes as high as 105° or 106° F. This is called *fever*. It is often one of the first signs of sickness, especially in contagious diseases.

40. Care of the Skin.—The skin cannot do its work properly unless it is kept clean. The dead cells which are constantly being shed from the scarf skin are caught by the secretion of the oil glands and held on the skin. When the perspiration evaporates, it leaves on the skin all the solid matter that it contains. From these two sources, waste matter is always collecting on the skin, where it clogs up the pores, irritates the skin, catches and holds disease germs, and gives rise to unpleasant odors. To get rid of it, the whole body must be washed thoroughly with soap and warm water at least once a week, several times a week in summer, because perspiration is much more abundant then.

41. Warm Baths.—Warm baths dilate the blood-vessels that lie near the surface of the body, causing them to become engorged with blood. The skin becomes red, and the whole body feels warm. There is more blood in the skin and in the tissues just under the skin, but there is less blood in the brain and in the organs of the chest and the abdomen. Hot foot-baths are particularly useful in drawing blood away from the head and the chest, and for this reason they will often relieve headache, reduce fever, and break up colds. By drawing blood away from the internal organs, warm baths will often relieve fatigue. At night they will often bring sleep to persons troubled with sleeplessness. In cold weather one should not go outdoors immediately after a warm bath because of the danger of catching cold. It is best to take warm baths at night, just before retiring.

42. Cold Baths.—Warm baths dilate the blood-vessels of the skin and bring more blood to the surface of the body. The first effect of a cold bath is just the opposite. Cold causes the blood-vessels to contract, so that there is less blood in the skin. The skin is pale in color and feels cold. In healthy, robust persons this lasts only a few minutes. The heart is stimulated, the blood is forced back to the surface of the body, and in a few minutes the skin glows with warmth. This is called the *reaction.* Rubbing the skin briskly with a coarse towel helps the body to react. It is the reaction that makes cold baths valuable. Persons who do not react promptly should not take cold baths; and no one should stay in cold water until the reaction passes off and the body again feels chilly.

When reaction occurs promptly, cold baths are very useful in stimulating and strengthening the heart, the lungs, and the other internal organs. They train the skin to resist cold and dampness and in this way help to prevent colds. To avoid taking cold, it is especially valuable to bathe the neck, shoulders, and chest, and the ankles and feet in cold water every morning. Sturdy persons soon learn to enjoy a daily plunge in cold water on arising in the morning. The temperature of the water should be about 70° F. Those not accustomed to cold baths may get used to them gradually by starting with the water at 90° or 95° F., and using it a little colder each morning.

Salt water is more stimulating to the skin than fresh water. Sea bathing is very beneficial, but one should never remain in the water after feeling chilly, nor more than a half-hour at any time.

Neither hot baths nor cold baths should be taken just before meals. One should not take a cold bath within two hours after a full meal because of the danger of interfering with digestion.

In some homes, particularly in the country, there are no bath-rooms or bath-tubs. A basin of water and a sponge or a cloth are all that are really necessary. With these one may keep the skin clean just as well as if one had a bath-tub, even if it is not so convenient. No one likes to wear dirty clothes, but they are really less dangerous than a dirty skin.

43. Care of the Hair and the Nails.—The hair should be brushed thoroughly every day. This increases the flow of blood to the scalp, helps to keep it clean, and, by spreading the oil along the hair, keeps it from getting too dry. The hair and the scalp should be washed thoroughly with soap and warm water every week or two. The hair must be dried carefully after washing it.

As we grow old the hair loses its pigment and turns gray or white. Old people sometimes dye their hair to make themselves look young. This is a dangerous practice. Many hair-dyes are poisonous. So are liquids used to bleach the hair.

Dandruff is a disease of the scalp that is probably caused by germs growing in the hair follicles. Persons who have dandruff should not use combs and brushes that are used by other people. Public combs, brushes, and towels should never be used by any one.

The nails should be trimmed even with ends of the fingers at least once a week. Biting the nails is a bad habit that is hard to break. It spoils the nails and makes the fingers sore. The skin around the root of the nail sometimes becomes fastened to the nail, and as the nail grows the skin is pulled out with it until it tears off in narrow strips called "hangnails." These are often very sore and painful. They should be cut off close to the flesh with sharp scissors. They may be prevented by gently pushing the skin back from the nail. The nails must be kept clean. The dirt that collects under the nails contains a great many bacteria. When these get into a wound they may cause blood-poisoning.

44. Clothing—Its Purpose.—Clothing is used to keep the body warm in winter, to keep it dry in wet weather, to shield it from excessive heat in summer, to protect it from injury, and for adornment.

45. Materials Used for Clothing.—The materials commonly used for clothing are cotton, linen, wool, silk, leather, furs, and rubber.

Cotton and linen allow the perspiration to pass off more readily than any other materials. For this reason strong, healthy people should wear cotton or linen next the skin at all seasons. Loosely woven clothing has a great deal of air in the spaces between the fibers and holds the heat better than closely woven material. Linen mesh is one of the best materials for underwear.

Clothing does not *give* any heat to the body; it simply *keeps in* our own bodily heat. Some kinds of clothing do this much better than others. Cotton and linen are good conductors of heat, that is, they allow heat to pass through readily. Wool and silk are poor conductors; they do not allow heat to pass through easily. Furs hold the heat even better than wool. In very cold weather nothing is warmer than furs. In winter we usually depend upon woolen clothing to keep us warm. People who are subject to rheumatism or who take cold easily often find it best to wear wool next the skin throughout the year. Just as loosely woven cloth is warmer than that which is closely woven, so two thin garments are warmer than one heavy garment of the same weight. In winter we should not wear in the house clothing that is warm enough outdoors. It is much better to put on extra clothing when we go out.

Cotton and linen garments are best in summer because they allow the heat of the body to pass off readily. White clothing is cooler than dark because it takes up less of the sun's heat.

Clothing must not be so tight as to interfere with the free circulation of the blood. As far as possible, the weight of clothing should hang from the shoulders and not from the waist.

46. Danger of Damp Clothing.—Wet clothing allows the heat of the body to escape very rapidly. The body becomes chilled quickly. Colds, pneumonia, and other diseases of the lungs and the air passages are often caused by damp clothing. Wet feet are especially likely to cause colds. Wet clothing should be changed as soon as possible. If one cannot change at once, it is best to keep warm by brisk exercise.

47. Care of Clothing.—Clothing must be kept clean. Underwear should be changed every week, several times a week when the weather is warm and when one has been perspiring freely. Clothing holds dust readily, and dust sometimes carries disease germs. Clothes should be brushed thoroughly every day. It is best to do this in the open air. It should never be done in the sleeping-room. It is wise to have clothing well aired when it is taken off at night, and to air the bedding thoroughly during the day.

48. Effect of Alcohol and Tobacco on the Skin.—Alcohol dilates the capillaries of the skin, so that they contain more blood than usual. This is what makes the skin feel warmer after taking alcohol. Really the body is losing heat faster than it should. Those who have been taking alcoholic liquors are always the first to freeze to death in very cold weather.

If the use of alcohol is continued for a long time, the capillaries are permanently enlarged. These swollen blood-vessels give the drunkard his red nose and flushed face. In the skin of the drunkard's face one can often see these dark, swollen, crooked vessels. This diseased skin cannot do its share of the work in removing waste matter from the body, and the kidneys are overworked trying to do their own work and that of the skin.

Tobacco often gives the skin a muddy, yellowish color, and makes it dry and harsh.

49. Function of the Kidneys.—When protein food is used up in the body, it leaves behind a kind of waste matter called *urea.* Urea resembles common ammonia. It is a deadly poison. If it is not removed from the body it will cause death in a few days. Unlike carbon dioxide, which is a gas, urea is a solid. It is easily dissolved in water. A small part of it is excreted by the skin, but most of it is thrown off through the kidneys. The function of the kidneys is to remove from the blood the waste matter formed when protein material is used up in the body.

50. The Kidneys.—The kidneys are two bean-shaped organs, about 4½ inches long and 1½ inches wide. They lie close to the backbone, just inside the lower ribs (Fig. 9). A large artery runs from the aorta to each kidney. The urea which has been formed by the wearing out of protein material is taken out of the blood by the kidneys, together with a quantity of water. Two small tubes, one from each kidney, carry the urine to the bladder. About 3 pints of urine are excreted daily. If the quantity is much larger or much smaller than this, it indicates serious trouble with either the kidneys or the bladder, and a physician should be consulted at once.

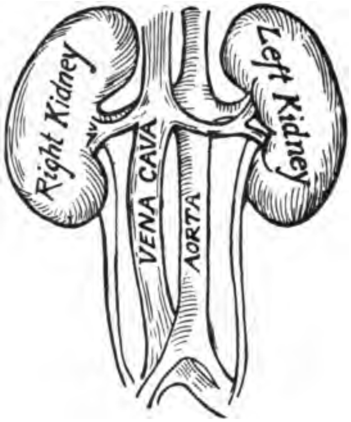

Fig. 9.—The kidneys.

51. The Care of the Kidneys. — More than 100,000 people die in this country every year of diseases of the kidneys. Many of these deaths could be prevented if people knew how to care for the kidneys. The most common causes of kidney disease are the use of alcoholic liquors, eating excessive quantities of meat, exposure to cold and wet, and certain contagious diseases, especially scarlet fever. All of these things should be avoided if we wish to have healthy kidneys.

The use of alcoholic liquors is one of the most common causes of kidney disease (Bright's disease). Nearly all men who use strong drink regularly have kidney disease sooner or later, and many of them die of it. Eating excessive quantities of meat is harmful because meat contains large amounts of protein, and the burning up of this protein in the body produces such large amounts of urea that the kidneys are badly overworked. Exposure to cold and wet closes the pores of the skin and checks perspiration. Waste matter that should be thrown off through the skin must then be removed by the kidneys. Healthy, active sweat glands help very much in keeping the kidneys healthy.

It is necessary also to drink plenty of water, for the waste matter removed by the kidneys cannot be excreted unless it is dissolved in water. It is very difficult for the kidneys to rid the body of urea if little water is taken. A grown person should drink 3 or 4 pints of water daily.

We must remember, too, that kidney disease is entirely too serious to be treated by any one who is not a trained physician. The kidney remedies advertised in many of the newspapers are all dangerous or useless and should never be used. Many of them contain large quantities of alcohol and are more likely to cause kidney disease than to cure it. No one should think of treating himself for so serious a condition.

QUESTIONS

Explain fully, in your own words, what is meant by *excretion*. What are the things that must be excreted? Where do they come from? Why is it necessary to get rid of them? How does the body get rid of them?

Describe the structure of the skin. Give the use of each part.

Describe a hair and a hair follicle. What is the use of the hair? Of the nails?

What are the sweat glands? What are the uses of perspiration?

Tell in your own words how the temperature of the body is regulated. What is the normal temperature? What is fever? What does fever indicate?

Tell how to care for the skin.

Explain the effects and give the uses of warm baths. Of cold baths.

Tell how to care for the hair and the nails.

What are the uses of clothing? Name some article of clothing that is used for each of these purposes.

Name the materials commonly used for clothing. Give the advantages and the disadvantages of each. For what purpose is each used? Which are best in warm weather? Why? Which are best for warmth in winter?

Why is damp clothing harmful? What should we do if we cannot change damp clothing at once? Why?

How should clothing be cared for?

What is the effect of alcohol and of tobacco on the skin?

Explain in your own words the function of the kidneys.

Describe the kidneys.

Why is it important to keep the kidneys healthy? What things should we do and what should we avoid to keep the kidneys healthy?

CHAPTER IV

DIET AND COOKING

52. Importance of Diet.—The food which we eat from day to day is called our *diet.* The study of diet is very important. There is nothing else that has so much to do with our health as our food and drink. A great many people are unable to do their best work or to get the greatest enjoyment out of life because they do not know the kind of food or the amount of food that is best for them. The farmer knows what to feed his cows to make milk and what to feed his hogs to fatten them, but very often he does not know what to feed his children to keep them well and strong. Many a man is much more careful about the oil and gasoline he orders for his automobile than he is about the food he buys for himself.

53. Uses of Food.—Food has two great uses: first, to furnish heat and power; second, to build up and repair the tissues of the body.

Food is used up in the body just as coal is used up in the engine. It is burned up or oxidized to provide heat and energy. Foods that are used chiefly to supply heat and power are often called *fuel* foods.

If an engine is kept going night and day, without stopping, as some parts of our bodies are, it will soon wear out. There are many parts of our bodies that are constantly wearing out. To keep our bodies well and strong, all wornout parts must be built up again. We need food to *build* with, as well as to produce heat. Children especially need plenty of *building food;* for they must have food to grow, to make new tissue, as well as to repair wornout parts of the body.

54. Kinds of Food.—The foods that give most heat and energy all contain a large amount of *carbon.* It is the carbon that is burned up in the body to produce heat and power. The fuel foods are often called the *carbon foods.* There are two kinds of carbon foods. The first kind consists of starch and sugar. Starch and sugar together form a class of foods called the *carbohydrates.* The second kind of carbon foods consists of *fat* and *oil.*

All the tissue-building foods contain a substance called *protein.* The cells of our bodies are composed largely of protein. The body uses the protein of our food to build up and repair the tissues. The building foods are often called the protein foods. Lean meat, eggs, beans, and peas are all rich in protein.

55. Animal, Vegetable, and Mineral Food.—All living things are made up of materials taken from the earth and the air. The apple that you eat was made by the tree from things which it got from the air and the ground. Plants take their food directly from the earth and the air. Animals cannot do this.

Their food must be prepared for them by plants. The materials they need for the growth and repair of their bodies must first be taken up from the earth by plants; and only after these materials have become part of the plant can they be used by the animal.

Some animals, indeed, cannot use even vegetable food. They depend for their food upon the flesh of other animals. Their food, too, comes from the earth; but before they can use it, it must be changed, first into plants, and then into the flesh of some animal. The rabbit eats the grass of the field and turns it into flesh and blood. The fox cannot live on grass; his food is the flesh of the rabbit and of other animals.

Some animals eat only vegetable food. Others eat only animal food. Every animal has teeth and stomach suited to the kind of food it eats. The teeth and the stomach of man teach us that he can use both animal and vegetable food.

Among the most important *animal foods* are beef, pork, mutton, fish, poultry, eggs, milk, butter, and cheese. The most important *vegetable foods* are the cereals (wheat, corn, rye, oats, buckwheat, barley, and rice), potatoes, beans, peas, cabbage, and other garden vegetables, fruits, and nuts.

Besides the animal and vegetable foods we must have a certain amount of *mineral matter* for the growth of the bones and the teeth, and we must have a large amount of *water*. These two things form a very necessary part of our diet.

56. The Food Elements.—Nearly all the common foods are used by the body both for fuel and for tissue-building. Most of the common articles of food contain some protein, some carbohydrate, and some fat. Nearly all of them contain a large amount of water and a small amount of mineral matter. These substances are called the *food elements*. There are *five food elements—water*, *mineral matter*, *carbohydrates* (starch and sugar), *fat* and *oil*, and *proteins*.

Water makes up almost three-fourths of the weight of the body. The processes by which life is maintained cannot be carried on properly without a plentiful supply of water. A man may live without food for several weeks if he has plenty of water, but without water he will die in a few days.

Mineral matter is needed especially to give hardness to the bones and the teeth and to make good blood. Salt is used with many articles of food. Other minerals needed by the body are iron, lime, sulphur, and potash. These are found in green vegetables, cereals, meat, and in our drinking-water.

The *carbohydrates* (starch and sugar) give heat and energy when they are used up in the body. They are obtained almost entirely from vegetable food, although there is some sugar in milk. Starch is found in all of the cereals, in potatoes, beans, peas, and other vegetables. Sugar is obtained from the juice of the sugar-cane and the sugar-beet. Nearly all ripe fruits contain some sugar.

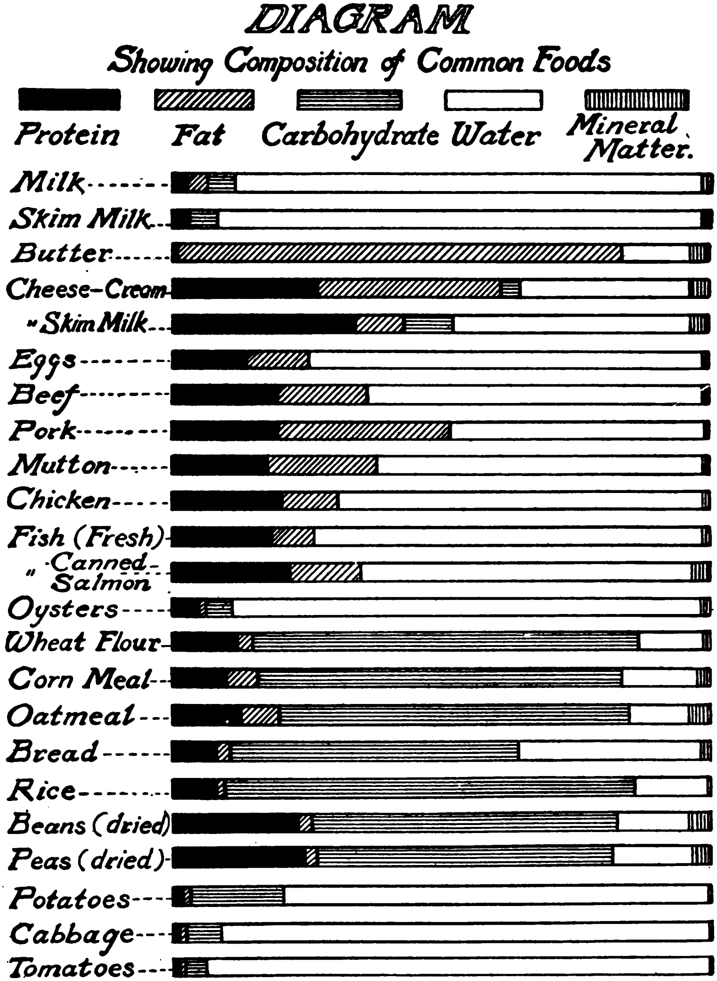

Fig. 10.—Food elements in common articles of diet.

Fat and *oil* are our best fuel foods. They are found in both animal and vegetable foods. All meats contain some fat; some are very rich in fat. Butter and lard are practically all fat. The common vegetable oils that are used for food are olive oil and cotton-seed oil.

The *proteins* are tissue-building foods. They are found in both animal and vegetable foods. The white of eggs contains a protein called *albumin*. *Casein* is a protein found in milk. All the cereals contain a protein called *gluten*. *Gelatin* is a protein obtained from bones and gristle.

The body will not remain in perfect health for any length of time unless it is supplied with the necessary amount of each of these food elements. If we take too little of any one of them we lose in weight and strength. If we take too much the body is burdened with material which it cannot use, the organs that must get rid of it are overworked, and we suffer in health. No one can tell *exactly* how much protein, how much fat, and how much sugar or starch the body needs; but we do know *about* what amount is required. We can tell the smallest amount that will meet the needs of the body, and the largest amount that the body can use; and we can easily arrange our diet to keep within these limits.

57. Amount of Food Needed.—A laboring man doing an ordinary amount of hard work needs about the following amount of each food element daily:

Protein	4	ounces.
Fat	3	"
Carbohydrate	12	"

Some men do not need more than 2 ounces of protein per day; others use as much as 6 ounces. One should try to keep within these limits. The allowance of fat and carbohydrate varies even more. Some men eat practically no fat. The Eskimo frequently uses several pounds daily. The Eskimo, on the other hand, can get almost no carbohydrate, while men in temperate climates may use as much as 20 ounces. It takes a little more than 2 ounces of carbohydrate to give as much heat as we get from 1 ounce of fat; and if a man gets less than 3 ounces of fat per day he must take an additional quantity of carbohydrate in its place. Women usually require about one-fifth less of all kinds of food than men.

These figures show the amount of actual nourishment required by the body, not the total weight of food needed. Only a part of the food we eat is actually used by the body. To get 1 ounce of protein, we must eat 5 ounces of meat or 12 ounces of bread. No man could live and do his work on 19 or 20 ounces of food. He must have enough food to give him that much actual nourishment, or from 3 to 5 pounds of food each day.

To select the food that will give us the proper amount of each of the food elements it is necessary to know of what our ordinary foods are composed.

58. Cereals.—*Wheat* is the most widely used grain in Europe and America. It is rich in protein (gluten) and in starch, but it contains only a small amount of fat. We eat butter with bread to increase its fuel value. Bread and butter make a splendid food, and one could live for a long time on it alone. Whole wheat bread is no more nourishing than white bread, and it is not so easily digested. White bread contains about 8 per cent. (8 parts in 100) of protein, 2 per cent. of fat, and 55 per cent. of carbohydrate. A loaf of bread weighing 1 pound contains about 1⅛ ounces of protein, ⅛ ounce of fat, and 9 ounces of starch (Fig. 11).

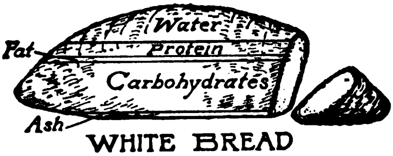

Fig. 11.—Food elements in bread.

Oatmeal has about one and one-half times as much protein as wheat bread. It has more fat than any other cereal. Well-cooked oatmeal is one of the very best foods for growing children.

Corn contains almost as much protein and fat as oats. Cornmeal is a nourishing and wholesome food, and is very widely used. It contains about 12 per cent. of protein, 5 per cent. of fat, and 70 per cent. of carbohydrate. In a pound of cornmeal there are about 2 ounces of protein, 1 ounce of fat, and 11 ounces of starch. Well-cooked cornmeal, with cream, is an almost perfect food.

In Asia millions of people live almost entirely on *rice*. It has less protein and more carbohydrate than any other grain. It is an excellent food for heat and energy, but a poor tissue-builder.

59. Beans, Peas, and Potatoes.—Beans and peas are very rich in protein. They contain even larger amounts of tissue-building food than most meats. The protein of beans and peas, however, is of a different kind from that of meat or of the cereals; and part of it cannot be used by the body. Beans and peas should be cooked thoroughly. They are very nourishing, much cheaper than meat, and may often be used in its place. They are not so easily digested as meat, and cannot fully take its place as a daily food.

Potatoes are more than three-fourths water. They have no fat and only a small amount of protein. About 20 per cent., or one-fifth, of the potato is starch. Baked potatoes, eaten with butter, or boiled potatoes with meat or meat gravy, are satisfactory foods. Eaten alone they do not make a satisfactory food.

60. Fruits and Green Vegetables.—Most of these are made up largely of water and contain but little nourishment. They are valuable additions to our food-supply, however, especially during the summer. They supply the body with mineral matter and with acids which are helpful, and they assist in keeping the digestive system healthy.

Only sound, ripe fruit should be used as food. During the summer months much sickness is caused by eating unripe or overripe fruit. Many persons find stewed fruit more wholesome than uncooked fruit.

61. Meats.—Meats furnish most of the protein or tissue-building material of our diet, and a great deal of the fat. The amount of protein in meats varies from 15 to 25 per cent. A pound of meat contains from 2½ to 4 ounces of protein. In lean beef there is about 5 per cent. of fat, or a little less than 1 ounce in each pound. Salt pork is three-fourths (75 per cent.) fat. A pound of good beefsteak contains about 4 ounces of protein and 2 ounces of fat. The rest is water.

Pork has more fat than other meats. This makes it a good fuel food, but it is not so easily digested as other meats because the fat keeps the gastric juice in the stomach from acting on the protein. Pork is a good food for those who work hard or exercise a great deal. Some people find it hard to digest.

The flesh of chickens has over 20 per cent. of protein, and the amount of fat is usually much smaller than in beef or pork. This makes it an excellent food for invalids.

Beef and mutton are the best meats for general use. They are highly nourishing and easily digested. Some cuts of beef, like sirloin steak, are much more expensive than others. The cheaper cuts are just as nourishing and, if properly cooked, just as easily digested. Some people dislike the taste of mutton and cannot eat it, although it is very nourishing and easily digested. Mutton broth is almost as good a food for invalids as chicken broth.

Fish has almost as much protein as meat, but it is not always easily digested. This is particularly true of herring, mackerel, salmon, and shad, which contain a great deal of oil. Shell-fish—oysters, clams, crabs, and lobsters—are expensive foods and do not contain much nourishment. Oysters are easily digested, especially when eaten raw.

62. Preservation of Meat.—Meats and fish are preserved by drying, by smoking, by salting or pickling in brine, and by boiling and packing in air-tight cans. Fresh meat is more nourishing and more easily digested than any form of preserved meat. If meat is kept at a freezing temperature it will stay fresh and good for several years.

If fresh meat is not properly cared for, it spoils quickly. Tainted meat is sometimes used in making sausages and canned meats. This is not safe, as such meat may contain deadly poisons called ptomains. Ptomains are not destroyed by boiling. Spoiled meat cannot be made safe by cooking. Shell-fish that are not fresh are very apt to contain ptomains.

63. Danger of Raw Meat.—Meat should never be eaten raw or only partly cooked. Tapeworm is caused by eating uncooked beef or pork. Uncooked pork is more likely than other meats to cause disease. This can be avoided by thorough cooking.

The flesh of diseased animals should never be used for food. The United States Government now employs inspectors to examine all meat shipped from state to state. Most large cities have their own inspectors to examine meat dressed in the city.

64. Milk and Milk Products.—Milk is often called the perfect food because it contains all the things needed by the body. One can live for a long time on milk alone. This is not true of any other food. Milk is not a perfect food, however, except for very young children. Good milk contains about 3½ per cent. of protein, 4 per cent. of fat, and 5 per cent. of carbohydrate in the form of sugar of milk (Fig. 12). One quart of milk (32 ounces) contains about 1 ounce of protein, 1¼ ounces of fat, and 1½ ounces of sugar. To get the 4 ounces of protein that a workingman requires he would have to take about 4 quarts of milk every day; and even then he would get only one-half of the carbohydrate he needs. Milk is a perfect food for babies because they need much less nourishment than grown persons. It is a valuable food for all persons, and one of the best we have in sickness; but it does not contain enough nourishment to serve as the only food for healthy adults or for school children.

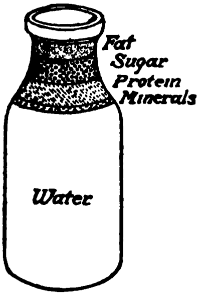

Fig. 12.—Food elements in milk.

Butter.—When milk is allowed to stand for a few hours most of the fat rises to the top in the form of cream, because it is lighter than the rest of the milk. The cream may be "skimmed off," and what is left is called "skim-milk." In large dairies a machine called a "separator" is used to separate the cream from the milk.

Cream itself is sometimes used as a food. Usually it is made into butter. The cream is placed in a churn, where it is stirred or shaken very rapidly until all the fat collects as little lumps of butter. What is left is called buttermilk. Butter contains 85 per cent. of fat and 1 per cent. of protein. In 1 pound of butter there are about 13½ ounces of fat and ⅙ ounce of protein. The rest is water and salt. Butter is one of the best fuel foods we have. It is particularly useful with bread, rice, potatoes, and other starchy foods.

Skim-milk and Buttermilk.—Both skim-milk and buttermilk are valuable foods. Skim-milk contains just as much protein as whole milk, but it has very little fat. Buttermilk has no fat. It contains an acid which many persons find very beneficial.

Cheese.—The protein of milk is called casein. If milk is allowed to stand in a warm place it soon turns sour, and in a few hours more it becomes thick, just as it does when your mother makes junket. The thick curd is made up of casein and fat. From the curd cheese is made. Cheese may be made of whole milk ("full cream" cheese) or of skim-milk. It contains from 25 to 30 per cent. of protein and from 10 to 35 per cent. of fat. Cheese is a very nutritious food. Most kinds of cheese are easily digested if they are eaten in moderate quantities; and they supply more nourishment per pound than almost any other food.

65. Eggs.—The white of eggs is made up almost entirely of water and protein (albumin). The yolk contains a large amount of fat. A dozen eggs, which weigh about 1½ pounds, contain 3¼ ounces of protein and 2½ ounces of fat. A dozen eggs furnish about the same amount of nourishment as 1 pound of beefsteak.

The more an egg is cooked the harder it is to digest, as heating coagulates the protein. Raw eggs, beaten up in milk and sweetened, form a palatable and very nourishing food. The white of eggs, dissolved in water (albumin-water), is often given to infants and to sick people who can take no other food.

66. Table Showing Composition of Common Articles of Food.—Figures represent percentage of each substance, or parts per hundred:

Food.	Water.	Protein.	Fat.	Carbohydrate.	Mineral Matter.
Milk	87.0	3.3	4.0	5.0	0.7
Skim-milk	90.4	3.2	0.7	5.0	0.7
Butter	11.0	1.0	85.0	...	3.0
Cheese, Cream	31.5	27.0	35.0	2.5	4.0
Cheese, Skim-milk	45.0	35.0	8.0	8.0	4.0
Eggs	73.5	13.5	12.0	...	1.0
Beef	55–75	15–25	3–30	...	1.0
Pork	40–60	15–25	15–50	...	1.0
Mutton	50–65	16–20	12–30	...	1.0
Chicken	60–70	20–22	3–15	...	1.0
Fish (Fresh)	65–80	18.0	0.5–15	...	1.0
Canned Salmon	63.5	22.0	12.0	...	2.5
Oysters	87.5	6.0	1.0	3.5	2.0
Wheat Flour	11.5	12.5	2.0	73.0	1.0
Cornmeal	13.5	10.0	5.0	70.0	1.5
Oatmeal	11.5	12.0	6.0	67.5	3.0
Bread	34.0	8.0	2.0	55.0	1.0
Rice	12.0	8.0	0.5	79.0	0.5
Beans (Dried)	13.7	23.0	1.8	58.0	3.5
Peas (Dried)	15.0	24.0	1.5	56.5	3.0
Potatoes	78.0	2.0	0.2	18.8	1.0
Cabbage	91.0	1.8	0.2	6.0	1.0
Tomatoes	94.3	1.0	0.4	3.8	0.5

67. Table Showing Number of Ounces of Each Food Element Furnished by One Pound of Certain Foods:

One Pound of	will furnish the number of ounces indicated of			
	Protein.	Fat.	Carbohydrate.	Total.
	Oz.	Oz.	Oz.	Oz.
Milk	0.5	0.6	0.8	1.9
Butter	0.2	14.6	...	14.8
Cheese (Cream)	4.3	5.6	0.4	10.3
Eggs (8 to 10)	2.2	1.8	...	4.0
Beef (Medium Fat)	3.2	2.5	...	5.7
Pork (Medium Fat)	2.4	6.0	...	8.4
Mutton	3.2	3.0	...	6.2
Chicken	3.5	0.5	...	4.0
Oysters	1.0	0.2	0.5	1.7
Cornmeal	1.6	0.8	11.2	13.6
Oatmeal	2.0	1.0	10.8	13.8
Bread	1.3	0.3	8.8	10.4
Rice	1.3	0.1	12.6	14.0
Beans	3.6	0.3	9.3	13.2
Peas	3.8	0.2	9.0	13.0
Potatoes	0.3	...	3.0	3.3

68. Coffee, Tea, and Cocoa.—Coffee is made from the seeds of the coffee plant. There is no nourishment in coffee itself. When taken with cream and sugar it has a very slight food value.

Tea is made from the dried leaves of an evergreen plant that grows in southern Asia. The leaves are sometimes boiled with the water, but it is better to pour boiling water on the leaves and allow it to stand a short time to "draw." There is no nourishment in tea except as cream and sugar are added to it.

Both tea and coffee contain a substance called *caffeine*, which acts as a stimulant to the heart, the lungs, and the brain. Tea and coffee help to relieve fatigue, but they sometimes interfere with digestion and cause restlessness and sleeplessness. Neither of them should be used by children.

Cocoa is made from the seeds of the cacao tree, which grows in the tropical regions of America. Chocolate is made by grinding the seeds very fine and pressing the paste into cakes. It contains a large amount of oil. Powdered cocoa is made by removing a part of this oil. Both cocoa and chocolate are nourishing drinks. Cocoa is an excellent drink for children.

69. Balanced Diet.—To supply all the needs of the body our diet must contain protein, fat, and carbohydrate, and it must contain the right share or *proportion* of each. A grown person needs 3 or 4 ounces of protein, 3 ounces of fat, and about 12 ounces of sugar and starch every day. A diet that supplies these food elements in this proportion is a *balanced diet.* A man who drank 4 quarts of milk every day would get 4 ounces of protein, 5 ounces of fat, and only 6 ounces of sugar. This is not a balanced diet, because there is too little carbohydrate.

To get all the food elements in the right amounts we must use a mixed diet, that is, we must eat several different articles of food. Our own appetite tells us this. We prefer bread with butter, potatoes with butter or gravy, oatmeal with cream, cheese with crackers, and so on. In each case the two articles together form a better food than either alone.

The following lists show how different articles of food may be combined to furnish the amount of protein, fat, and carbohydrate needed by the body:

Daily Ration—No. 1.

	Protein.	Fat.	Carbohydrate.
	Oz.	Oz.	Oz.
Bread, 12.0 ounces	1.0	0.2	6.6
Butter, 1.0 "	....	0.8	....
Eggs (2), 3.5 "	0.5	0.4	....
Meat, 12.0 "	2.4	1.8	....
Milk, 16.0 "	0.5	0.6	0.8
Potatoes, 16.0 "	0.3	....	3.0
Totals, 60.5 "	4.7	3.8	10.4

Daily Ration—No. 2.

	Protein.	Fat.	Carbohydrate.
	Oz,	Oz.	Oz.
Bread, 16 ounces	1.3	0.3	8.8
Butter, 1 "	....	0.8	....
Milk, 16 "	0.5	0.6	0.8
Oatmeal, 4 "	0.5	0.3	2.7
Sugar, 3 "	....	....	3.0
Meat, 10 "	2.0	2.0	....
Potatoes, 16 "	0.3	....	3.0
Totals, 66 "	4.6	4.0	18.3

Garrison Ration, United States Army.

Beef or mutton (fresh), 20 ounces; or bacon, 12 ounces. On holidays, chicken or turkey, 16 ounces.

Bread, 18 ounces.

Beans, 2.4 ounces; or rice, 1.6 ounces; or hominy, 1.6 ounces.
Potatoes, 20 ounces.
Prunes, dried apples, or dried peaches, 1.28 ounces.
Coffee, 1.12 ounces; or tea, 0.32 ounce.
Sugar, 3.2 ounces.
Milk, evaporated, unsweetened, 0.5 ounce.
Butter, 0.5 ounce.
Vinegar, pepper, cinnamon, syrup, etc.

70. Common Errors in Diet.—There are three common errors in diet—eating too much protein, eating too little protein, and not eating enough fat.

Eating too much protein is a fault of the rich. To most people the proteins are the most appetizing foods, and those who can afford to do so are very apt to live largely on them. If we eat more starch or fat than the body needs, these foods may be stored up in the body for future use; but protein food is not stored up in this way. If we eat more protein than the body can use in building up and repairing the tissues, that which is not needed must be burned up and excreted without being of the slightest use to the body. This gives the organs of excretion a great deal of extra work. An excessive meat diet is a common cause of liver and kidney disease.

Starchy foods, like potatoes and rice, are usually the cheapest foods. Poor people sometimes live almost entirely on them. In many parts of Europe and Asia the working people eat little or no meat. People who live almost entirely on vegetable food usually do not get enough protein or fat. Without a sufficient supply of protein the tissues cannot be repaired as they wear out, and the body becomes thin and weak. Many children suffer from lack of protein. Proper growth is impossible without a sufficient supply of building material.

Fat is the most valuable of the fuel foods. An ounce of fat produces more than twice as much heat and power as 1 ounce of sugar or starch. Those who are engaged in hard labor should eat plenty of fat. The working-man cannot easily maintain his strength on a diet that does not have enough fat.

71. Preparation of Food.—The horse eats corn and oats as they come from the field. Before man can use them as food they must be ground into meal and cooked. Nearly all articles of food require special preparation. Most of the cereals are ground into meal or flour, and all of them must be thoroughly cooked before being eaten. All starchy vegetables must be cooked before they are fit to be eaten.

Even those fruits and vegetables which are eaten raw should be prepared by thorough *washing*. Vegetables are sometimes raised in soil that contains typhoid germs. Fruit always has some dust on it. It may have been handled by persons suffering from contagious diseases. The only safe rule is to wash all fruit and vegetables well before eating them. No one wishes to eat dirty food, and unwashed fruit and vegetables are always dirty.

72. Cooking.—There are three reasons for cooking food: first, to develop its flavor; second, to make it more digestible; third, to kill any disease germs it may contain.

If we think of the difference in taste between raw potatoes and baked potatoes, and between raw beefsteak and broiled steak, we can understand how cooking brings out the flavor of food and makes it more palatable. All meats and most vegetables are improved by cooking.

There are several ways in which cooking makes food more digestible. Food that is eaten cold must be warmed in the stomach before digestion can begin. The stomach need not do this extra work if food is eaten warm. Cooking makes food soft and tender, so that it is more easily chewed and more thoroughly mixed with the digestive fluids. Starchy foods, especially, should be well cooked. The tiny grains of starch are surrounded by tough envelopes of a woody substance. It is almost impossible for the digestive fluids to dissolve these coverings. Uncooked starch is very difficult to digest. Cooking breaks up these envelopes, bursts the starch granules, and makes them much easier to digest. The longer starchy foods are cooked, the more digestible they become. Most animal foods, however—like eggs, milk, and meat—are more easily digested if they are not cooked too long. Prolonged cooking makes the protein tough, and hard to digest.

73. Methods of Cooking.—There are two chief methods of cooking: first, by the use of *dry* heat, as in baking, roasting, and broiling; and, second, by the use of *moist* heat, as in boiling, stewing, frying, and steaming.

There is no better way to cook meat than the old-fashioned method of roasting it before an open fire. Meat prepared in this way has a better flavor, and is more digestible than when prepared in any other way. This method of roasting is hardly ever used now. What we call roasting is really baking.

Broiling is the best way to cook meat next to the old way of roasting. Steaks or chops should be cut thick, and the fire must be very hot. This coagulates the outer layers of protein and forms a coating which keeps in the natural juices of the meat.

Cooking with dry heat in an oven is called baking, although meat cooked in this way is commonly spoken of as roast meat. The oven should be very hot when the roast is put in, so that all the juices may be kept in the meat, as in broiling. Bread and cake are made by baking. Potatoes and beans are often cooked in this way.

Meats of all kinds are made tender and digestible by boiling. This is the best way to prepare the cheaper cuts of beef that are not suitable for broiling or roasting. The water should be boiling when the meat is put into it, so that the albumin on the outside of the meat may be coagulated and the juices and the flavor retained within. After ten to twenty minutes the temperature of the water should fall a little below the boiling-point and remain there until the meat is tender. Keeping the water at the boiling-point coagulates all the albumin and makes the meat tough.

In making soups, broths, and stews the object is to get all the flavor and the juices out of the meat. In this case the meat should be cut into small pieces, placed in cold water, and heated gradually.

Frying, if properly done, is really boiling in oil or in melted fat. These can be made much hotter than boiling water, so that the albumin on the surface of meat or fish is coagulated instantly. This retains all the natural juices in the meat, and at the same time keeps the fat from soaking in. The oil or fat must be deep enough to cover the food and must be kept very hot. Many foods, when fried, have a flavor that no other method of cooking can equal. Food fried in the right way is not unwholesome; but to allow food to soak up a lot of half-warmed fat, as is so often done in frying, is an exceedingly bad method of cooking.

74. Keeping Food Clean.—Everything possible should be done to keep food *clean*. We cannot be too careful about this. Dirty food is dangerous food. It is full of bacteria, and it may contain the germs of dangerous diseases like tuberculosis or typhoid fever. Food should be kept and sold only in places that are perfectly clean. It must never be exposed to dust or to flies, two of the greatest carriers of disease germs.

The less it is touched by human hands, the safer it is. Bread should never be sold unwrapped. Sugar, cereals, dried fruit, and many other foods can now be bought in sealed packages which protect them from dirt and dust. One should refuse to deal with a grocer who continues to sell these things from open bins.

It is just as necessary to *keep* food clean in the home as to buy it clean. The kitchen must be screened to keep out flies. There must be no dust or dirt in any place where food is kept or handled. The ice-box must have special care. The ice itself must be clean. The ice-box must be cleaned frequently and scalded out thoroughly at least once a week.

75. Preventing the Decay of Food.—Many kinds of food spoil very quickly if they are not properly cared for. In warm weather meat becomes tainted in a very short time. Tainted or decayed food is entirely unfit to eat. It often contains deadly poisons called ptomains.

All decay is caused by bacteria. Anything that will keep bacteria from growing will prevent the decay of food. Food kept on ice will not decay, because bacteria must have heat to grow. Fruit and vegetables will keep better in a cool cellar than in a warm room. Bacteria cannot grow without moisture. Many kinds of food may be preserved for a long time if they are thoroughly dried. The decay of food may be prevented by the use of salt or other preservatives, but such food is less nourishing and more difficult to digest than fresh food. Keeping food clean has a great deal to do with keeping it fresh, because food will not decay if there are no bacteria in it.

76. Pure Food Laws and Food Inspection.—When our country was first settled each family raised all of the food that it used. As towns and cities grew up, and people engaged in manufacturing and similar industries, it became impossible to do this. Today people who live in cities buy all of their food from stores or markets. Even the farmer buys his sugar, flour, and many other foods, instead of producing them himself.

When people ate only what they had produced themselves it was easy to make sure that the food was clean and pure. When we buy our food from the store or the market we cannot tell how it has been handled or what has been mixed with it. Food may become impure not only through careless handling, but by having harmful substances mixed with it. Cakes are colored with a kind of dye to make them look as if they were made with eggs. Chocolate candy is coated with shellac, a kind of varnish, to make it shiny. Tainted meat is made into sausages, and chemicals are used to make them look and taste as if they were made of good meat. Such food is said to be *adulterated*. All adulteration of food is dishonest and much of it is dangerous to health.

To prevent the adulteration of food the United States Government has a law called the Pure Food

Law. Many states and cities have Pure Food Laws of their own to prevent both the adulteration and the careless handling of food, and in this way protect the health of the people. Most cities and states employ men to inspect the food sold in our stores and markets and to see that it is clean and pure. The Food Inspectors prevent a great deal of sickness that might be caused by the sale of impure food.

77. Importance of Pure Milk.—Since very young children live almost entirely on milk, it is very important to use only pure, clean milk. More children under one year of age die from using poor milk than from any other cause. Disease germs get into the milk, where they grow very rapidly if the milk is not kept on ice. These germs are carried with the milk into the bodies of little children, who are often killed by them. In large cities the Board of Health employs milk inspectors to see that only pure milk is sold, but this cannot always be done in smaller towns and in the country. Here each one must be his own inspector and make sure that the milk comes from healthy cows and that it is kept clean.

78. How to Produce Good Milk.—To produce good milk the dairyman must have healthy cows. Tuberculosis is very common among cattle. The milk of tuberculous cows is not safe. It is likely that young children often get tuberculosis from such milk. To prevent this, all dairy cattle should be tested several times a year to make sure they do not have the disease. Many states now employ men to do this work. To keep cows from getting the disease they should be kept in clean, dry stables; and they must have plenty of fresh air and sunshine.

The germs of typhoid fever, scarlet fever, and diphtheria may get into milk from the hands or the clothing of persons who handle it. Epidemics of typhoid fever have often been caused by milk. The germs may be in the water used to wash the cans and bottles, or on the hands of some one who handles the milk. No one should be allowed to handle milk who has any contagious disease or who is attending someone else who has any such disease. All milk pails, cans, and bottles should be rinsed in boiling water before they are used.

The cows must be kept clean. There must be no dust in the stables at milking time, and the milker must wash his hands thoroughly just before milking. The milk should be drawn into a pail covered with a piece of cheese-cloth, which will keep out dust and strain the milk.

The milk should be cooled at once and kept cold until it is used. This will not destroy any germs that may be in it, but it will keep them from growing. Some cities do not allow the sale of milk that is warmer than 50° F.

Milk is usually shipped to the city in large cans holding 20 to 40 quarts. It is bottled by the milkman, and should never be served to families in any other way. The custom of dipping it out of an open can into pitchers and kettles is unclean and dangerous.

In warm weather milk must be kept in a *clean* ice-box or refrigerator. Clean, fresh milk can be kept sweet for several days in this way.

79. Pasteurized Milk.—Milk, like water, can be made absolutely safe by boiling it; but boiling changes the taste of milk and makes it harder to digest. When one is not sure that the milk is pure, it is best to Pasteurize it. The milk is heated to 160° F., at which temperature it does not boil, but all disease germs are killed. A dairy thermometer must be used; it can be bought for 25 cents. The milk must be kept at this temperature for twenty minutes, and then cooled quickly and *kept on ice.* Some cities do not allow the sale of milk that has not been Pasteurized.

QUESTIONS

Give some reasons for studying diet.

Explain the uses of food.

Name the two great classes of food, as to their use.

From what sources is our food obtained? Give examples.

Name the five food elements. Explain the use of each. Why should we know what these elements are?

Tell what amount of protein, of fat, and of carbohydrate is needed daily. Can one be substituted for another? Explain why.

Name the cereals in common use. Explain the food value of each.

What are the food values of beans, peas, and potatoes?

For what are fruits and green vegetables valuable?

Compare the common meats as to their food values. Which are best for ordinary use, and why? Of what value are fish? Shell-fish?

Explain how meats are preserved. What danger is there in tainted meats?

Why is raw meat unsafe? What meats are sometimes eaten uncooked?

Describe fully the value of milk as a food. What other foods are obtained from milk? What is their food value?

For what are eggs valuable? How does cooking affect their value?

Why do people drink coffee and tea? How are cocoa and chocolate made? What food value have coffee, tea, chocolate, and cocoa? Why should children avoid the use of tea and coffee?

Find out how many pounds of meat, bread, potatoes, and other food your mother usually prepares for a full meal. Estimate the amount of protein, fat, and carbohydrate in such a meal, and see how many ounces there are for each person. Use the tables in Sections 66 and 67.

Explain what is meant by a balanced diet. Tell why we should try to use a balanced diet. Prepare a "daily ration" different from those given in Section 69. Include some of the foods you like best. Use the tables in Sections 66 and 67, and see how much of each food you should order for six grown people.

Name the three common errors in diet, and tell how each affects the health.

What preparation does *all* food need?

Why do we cook food?

In what ways is dry heat used in cooking? Moist heat?

Explain the different methods of cooking in common use. Give the advantages and the disadvantages of each. Tell what things are cooked by each method, and when and how each method should be used.

Why must food be kept clean? How should it be kept clean?

How may the decay of food be prevented? Tell how different kinds of food are usually kept.

What is the purpose of pure food laws and food inspection? Do you know any foods that are regularly inspected? Some foods that do not require any inspection?

Why must special care be taken to use only pure milk?

What must the dairyman do to produce good milk? Give the reason for each thing.

What are the dangers of impure milk?

Describe a method by which milk may be made safe.

CHAPTER V

WATER SUPPLY

80. Importance of Water.—Almost three-fourths of the human body is water. The blood is four-fifths water. The muscles, which make up a large part of the weight of the body, are three-fourths water. Even the bones are almost half water.

Water is the great carrier within our bodies. The food we eat must be turned into a liquid before it can be used by the tissues. In the form of blood it is carried to every part of the body. All the waste matter produced in the body floats away in the bloodstream to the organs that excrete it. Without water there could be no blood, for the blood is four-fifths water. The fact that the quantity of water in our bodies is nearly three times as great as the quantity of all other things together helps us to understand how important it is. A man may live without food for several weeks if he has plenty of water, but without water he will die in a few days. Life cannot go on without a constant supply of good water.

The body is constantly losing part of its water. The air we breathe out of our lungs contains a large amount of water-vapor that it has obtained from the blood. About 1½ pints of water are lost in this way daily. In ordinary weather about 2 pints of water are lost each day through the skin in the form of perspiration or sweat. The kidneys take about 3 pints of water from the blood every day. Altogether the body loses from 6 to 8 pints of water daily.

81. Amount of Drinking-water Needed.—The body must be supplied with 3 or 4 quarts of water daily. Much of this is obtained from common articles of food. The meat we eat is almost three-fourths water. Milk is seven-eighths water. Bread is about one-third water, and potatoes are about four-fifths water. The amount of water we should drink depends partly upon the food we eat. Those who use much milk require less water.

A grown person should drink from six to eight glasses of water a day; and a child over twelve years of age almost as much. One is not likely to suffer any harm from drinking more water than is needed. A great deal of harm may be done by drinking too little water. There is no doubt that poor health is often due to waste matter which is not removed from the body as promptly as it should be, and that this is often caused by not drinking enough water.

82. Dangers of Impure Water.—Great care should be taken to use only pure water. Some of the most dangerous diseases, like typhoid fever and cholera, are caused by impure water. The germs of these diseases grow in the intestines of those who have the disease. These germs often get into wells and streams with the waste matters thrown off from the patient's body; and people who use this water for drinking are very likely to get the same diseases.

We cannot be sure that water is pure because it is clear. Disease germs are so small that they cannot be seen without a powerful microscope, and a glass of perfectly clear water may have millions of germs in it. There is only one safe rule to follow when we are not sure the water is pure—that is, to *boil all the drinking-water*. Boiling kills all disease germs, and *boiled water is always safe.*

83. Public Drinking Cups.—Disease germs may get into the body from the drinking cup as well as with the water in the cup. The common drinking cups sometimes placed in schools, railroad stations, parks, and other public places are sure to be used by persons who have infectious diseases. The germs of these diseases may be left on the cups, and other people using the same cups are sure to take the germs into their own bodies. One should *never* use a public drinking cup. It is always *dangerous.*

84. Sources of Drinking-water.—Drinking-water may be obtained by storing the water that falls as rain. In the country it is usually obtained from springs or wells. Cities generally get their water from rivers or smaller streams.

When rain-water is used it is collected from the roofs of the buildings and carried away through pipes, usually to underground cisterns, because these keep it cool. All the dust and dirt on the roof are washed off during the first few minutes of a rainfall; and the pipes should be so arranged that this water will run to waste, and only clean water will be carried to the cistern. Cisterns should be water-tight, so that no impurities may get into the water from the surrounding soil.

Springs and wells are often located on low ground. When it rains the surface water drains into them and carries dirt with it. Spring water should not be used for drinking if there are outbuildings or manure piles from which impurities can get into the spring.

Wells should always be on high ground and away from stables and other outbuildings. The outside of the well should be cemented for 8 or 10 feet below the surface of the ground. Clay or cement should be packed around the mouth of the well to raise it above the surface and to keep surface water from flowing into the well. The covering of the well should be water-tight and must be kept clean. Usually there are no germs in water that is found 8 or 10 feet underground. If the surface water can be kept out of the well the water will remain pure.

In towns and cities the water of ordinary wells should never be used for drinking. The soil is so full of impurities that well-water cannot be kept free from germs. The water of artesian wells is usually pure and safe.

85. Water Supply of Cities.—One of the most difficult problems of large cities has always been that of supplying pure water. Two thousand years ago the Romans brought the pure water of distant mountain streams to their city by means of stone canals or aqueducts which, supported by lofty arches of stone and cement, stretched away for scores of miles across the low plains that surround the city. These aqueducts are still used, and Rome today has one of the best water supplies of the world. New York has recently spent $200,000,000 for an aqueduct by which pure water is brought to the city from the Catskill Mountains, over 80 miles away.

Chicago, Cleveland, and other cities on the Great Lakes take their water from the lakes. It is pumped into the city through huge pipes or mains which lie on the bottom of the lake. As all the waste water of these cities runs back into the lake through the sewers, the water close to the shore is always very impure; and it has become necessary to extend the water mains farther and farther into the lake to secure water that is free from sewage. At Chicago it became necessary to stop emptying sewage into the lake, and a canal has been built to carry the sewage away from the city and empty it into the Illinois River, from which it finds its way to the Mississippi.

Most of our cities have been using the water of the rivers on which they are situated. While the cities were small and far apart the water of the rivers was safe enough. But as towns increased in number and in size, the water of these rivers became unfit for drinking, for all of the towns emptied their waste water, with all its filth, back into the river. Towns near the head of the stream still had pure water; but as town after town poured its sewage into it the water became more and more impure, until the larger cities at the mouth of the river found it entirely unfit for use.

Two things have been done to remedy this condition. First, it has been found possible to purify this water by filtering it. Second, laws have been passed in many states prohibiting cities from emptying their sewage into rivers, and requiring them to dispose of it in other ways.

86. Filtration.—It has been known for a long time that muddy water can be made clear by making it flow through a layer of powdered charcoal. The charcoal acts as a sort of sieve which catches and holds all the mud in the water and lets only the clear water pass through. This is called filtering the water.

If you will take a flower pot 8 inches deep, stuff a piece of sponge into the hole at the bottom, and place in the bottom a layer of coarse gravel 1 inch deep, on top of this 1 inch of fine gravel, and on top of this 3 or 4 inches of finely powdered charcoal, you will have a fairly good household filter. Muddy water poured on top of the charcoal will run from the sponge in the bottom perfectly clear. All the mud is caught by the charcoal. In a short time, of course, the charcoal becomes so full of mud that no more water will pass through; and part of it must be taken out and replaced with clean charcoal.

This simple household filter represents, on a small scale, what is now being done on a very large scale by many cities that take their drinking-water from rivers and lakes. Instead of a few square inches, the filter plants of large cities cover acres of ground. Instead of charcoal, fine sand is used for the top layer of the filter.

The filter used to purify the water for a large city consists of a large cement basin, with open drains underneath to carry off the pure water. In the bottom of the basin is placed a layer of coarse stone 1 foot deep. On top of this is another foot of fine stone, and above this 1 foot of gravel. The top layer consists of from 1 to 4 feet of fine sand. The whole depth of the filter bed is from 4 to 7 feet (Fig. 13). A filtration plant usually consists of a number of beds of this kind.

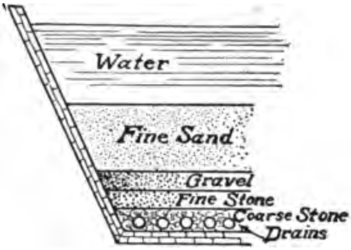

Fig. 13.—Section of a filter bed.

The "raw" water is pumped from the river to the filter bed until it stands from 4 to 6 feet deep above the sand. The water runs through the filter into the drains beneath, which carry it to the mains that supply the city. All the impurities in the water are caught in the upper layers of sand, nearly all of them in the top ¼ inch. Any germs that are in the water are caught and held with the mud and other impurities. In this way the water is made safe for drinking.

After a bed like this has been used for several weeks the water runs through very slowly, because the top layer of sand has become clogged with dirt. Then no more water is pumped to that bed. When the bed is dry the top inch of sand is scraped off, and the filter is ready for use again. The dirty sand removed from the filter can be washed clean and used again.

A filter bed of this kind, with a surface of 1 acre, will yield from 2,000,000 to 4,000,000 gallons of pure water per day, depending upon the amount of mud in the raw water. When the water is very muddy, it is sometimes pumped into large reservoirs and allowed to settle before being pumped on the filter beds.

The water flowing from the filter should be examined carefully every day by men specially trained for this work, to make sure that all germs are being removed from it. The cost of filtering the entire water supply of a large city is considerable, but it is much cheaper to pay this than to have people sicken and die of typhoid fever and cholera.

87. Sewage Disposal.—It would be much better, of course, if rivers were kept pure, and almost everywhere people are now trying to have this done. Many states have passed laws forbidding towns and cities to empty sewage into streams, and requiring them to dispose of it in other ways. In towns on or near the sea-coast, where the tide is high enough to produce a strong current when it runs out, sewage may safely be emptied into this tide water. It is carried out to sea and diluted so much that it does no harm. Inland cities can best dispose of their sewage by filtering it. The filters used to purify sewage are similar in most ways to those used for filtering water, but they work much more slowly. Such filters have been used for years in some cities, and they are entirely satisfactory.

As sewage filtration is a very expensive matter, and the money required to build filters cannot all be raised at once, it will take many years to complete the work. If no new sewers are built to empty into streams, and if the old sewers are gradually done away with, the time will come when all of our streams will again be clean and pure.

88. Amount of Water Needed in Cities.—Though people do not need more than 2 or 3 quarts of water a day to drink, cities find it necessary to supply very much larger amounts. Water is needed for many other purposes—for cooking, bathing, washing clothes, manufacturing, and for carrying away waste matter through the sewers. The total quantity required varies very much in different cities. Some European cities supply 40 or 50 gallons a day for each inhabitant. In American cities much larger quantities are usually furnished. Philadelphia and some other cities now supply more than 200 gallons per day for each man, woman, and child. There is no doubt that much of this is wasted. A supply of 100 gallons for each inhabitant has been found ample for all purposes. If the waste of water could be stopped the cost of the water supply could be reduced very much.

89. Garbage Disposal.—Getting rid of garbage is more a matter of good housekeeping and of cleanliness than of good health, though there are several ways in which garbage may become injurious to health.

All kinds of kitchen waste decay very quickly, especially in warm weather. Decaying garbage gives off gases which are very offensive and which make the air unfit to breathe. If garbage is not properly cared for or if it is not removed promptly, it attracts large numbers of flies; and flies are among the most common carriers of disease germs.

Garbage should be placed in metal cans. The cans should be kept tightly covered. They should be emptied daily and should be thoroughly cleaned at least once a week with boiling water. The wagons in which garbage is hauled away must be water-tight and should be tightly covered.

There are several ways of disposing of garbage after it has been collected. In the country it is often fed to hogs or buried. In some cities it is loaded on scows, taken out to sea, and dumped. In other cities it is either burned in large furnaces built for that purpose or boiled in large vats so that the grease may be separated from it. The grease is sold for making soap, and the rest of the cooked garbage is used in making fertilizers.

QUESTIONS

Why is water so important a part of our diet? How much water does the body need each day?

How much water should we drink each day? How does the body get much of the water it needs? What harm is done by drinking too little?

What are the dangers of using impure water?

Why should we avoid the common drinking cup?

From what sources is drinking-water obtained? What care must be taken with each of these? Tell how to make a well whose water will be safe.

How do cities usually get their water? What is the chief danger in lake water or river water? How may this be avoided?

Explain the method of filtering water for a large city.

What is the best way of disposing of sewage? Is it ever safe to empty it into a body of water?

How much water do cities usually supply for each inhabitant? Why is so much water needed?

Tell how to care for garbage in the home and what may be done with it after it is collected.

CHAPTER VI

THE NERVOUS SYSTEM

90. Purpose of the Nervous System.—Our bodies contain a large number of organs, each having some special work or function. The bones form the framework of the body and protect the delicate organs. The muscles produce all the different movements of the body. The stomach and intestines digest the food and prepare it for the use of the body. The lungs supply the body with oxygen to burn up this food and set free its heat and energy. The heart sends the blood to every part of the body, carrying food and oxygen to the tissues and carrying away all the waste matter of the tissues. The lungs, the skin, and the kidneys work day and night to remove from the blood the poisonous waste matter produced in the body.

Each part of the body needs the help of every other part. The muscles depend upon the stomach, the lungs, and the heart to keep them strong and healthy. The stomach must have good blood to do its work right. The heart depends upon the skin, the kidneys, and the lungs to keep the blood pure, and so on.

The body cannot be strong and healthy unless every organ does its work properly.

We must remember, too, that none of these things will keep going of itself. The muscles will not move our limbs unless there is something to make them contract. The stomach will not digest food and the heart will not pump blood if they are left to themselves. To keep them at work there must be something to direct them, to regulate them, and to control them. All this is done by the *nervous system.* "The nervous system is the great *master system* of the body." It governs, controls, and regulates all the other systems.

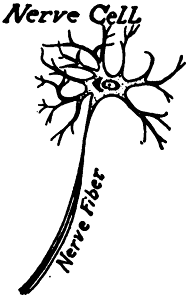

Fig. 14. — Nerve-cell and nerve-fiber.

91. Gray Matter and White Matter.—The nervous system is made up of *nerve-cells* and *nerve-fibers* (Fig. 14). The nerve-cells are gray in color and are usually clustered together in small groups or in large masses of nerve tissue. Because of their color, these clusters or masses of nerve-cells are called *gray matter.*

The nerve-fibers are tiny, glistening, white threads. Like the cells, they are commonly grouped together to form larger cords or thick bundles of fibers. These bundles of fibers are called *white matter.*

Every nerve-fiber grows out of a nerve-cell. It is really a part of the nerve-cell. We must keep this fact in mind if we would understand how the nervous system works.

92. The Functions of the Gray Matter and the White Matter.—To understand the *use* of the nerve-cells and the nerve-fibers we may compare them to an electric battery and a pair of wires, such as are used for electric bells. The electricity is produced in the jars or the "cells" of the battery. The wires carry the electric current from the battery to the bell.

In the nervous system the fibers of the white matter have exactly the same use as the wires of an electric battery—they *carry* nerve force or nerve impulses. Some fibers carry nerve impulses *away* from the cells; others carry messages *to* the cells.

The nerve-cells of the gray matter have two uses. Some of them are like the jars of the electric battery. They produce nerve force and *send it out* over the fibers that grow from them. Other nerve-cells are like the bell that is rung by the battery. They *receive* messages over the fibers that belong to them. The gray matter, then, has two uses—to send out messages and to receive messages. The white matter is used to carry messages.

The nerve-cells and nerve-fibers may also be compared to a telephone system. The fibers take the place of the wires; they simply carry the messages. The cells are like the receiver which you place at your ear or like the mouth-piece into which you talk. They either receive messages or they send them out.

93. Parts of the Central Nervous System.—

The largest and most important part of the nervous system is the *brain*. Growing downward from the base of the brain is the *spinal cord*. Connected with the brain and the spinal cord are the glistening, white cords called *nerves*. The nerves divide into smaller and smaller branches until they reach every part of the body (Fig. 15).

The brain, the spinal cord, and the nerves which grow from them form the *central nervous system*, or the *cerebro-spinal system*.

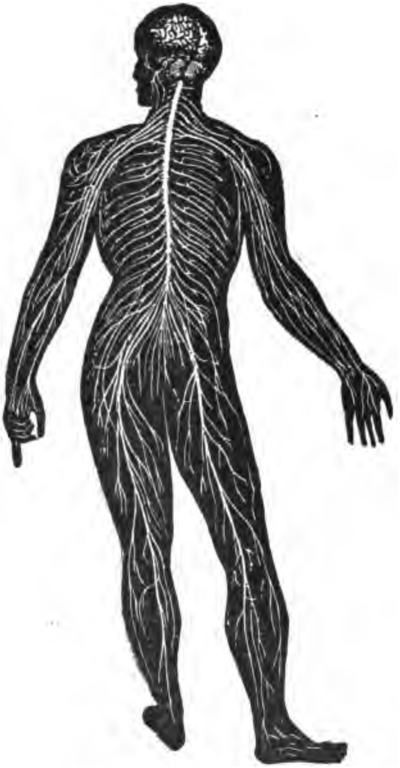

Fig. 15.—The nervous system.

94. The Brain.—The brain is enclosed by the bones of the skull, which surround it on all sides and protect it from injury. It is one of the softest and most delicate organs of the body. The brain of a grown person weighs about 3 pounds. The brain of man is larger than that of any other animal except the whale and the elephant. It is much larger in proportion to the size of the body than the brain of any of the lower animals. The surface of the brain is covered with a network of blood-vessels. One-eighth of all the blood of the body goes to the brain, although the brain may weigh only one-fiftieth as much as the rest of the body.

The brain is the seat of the mind. It is the brain that is working whenever we feel or think or use our will power—whenever we use our minds in any way. The nerve-cells with which we feel, taste, smell, see, and hear are all located in the brain. The brain controls all the voluntary movements of the body—all those movements which we make purposely, which we decide or *will* to make. The brain is connected by nerve-fibers with every part of the body, so that it can receive messages from and send out orders to every part of the body.

95. The Spinal Cord.—The spinal cord extends downward from the lower part of the brain. It is about 18 inches long and as thick as the little finger. It lies in the canal of the spinal column, to protect it from injury.

The spinal cord receives messages from different parts of the body and sends them to the brain. It receives orders from the brain and sends them out to different parts of the body. It contains nerve-cells which sometimes send orders to the muscles without waiting for an order from the brain.

96. The Nerves.—The nerves are white, glistening cords which grow out from the brain and the spinal cord. They divide into smaller and smaller branches, just as the arteries do, until they reach every part of the body. They act like the wires of a telephone system. They carry messages from all parts of the body to the spinal cord and the brain, and they carry orders from the cord and the brain to all parts of the body.

Twelve pairs of nerves, called cranial nerves, grow from the brain, and thirty-one pairs, called spinal nerves, from the spinal cord. Among the cranial nerves are the nerves of smell, taste, hearing, and sight. The cranial nerves and the spinal nerves together go to the skin of the entire body as nerves of touch. They also go to all the voluntary muscles of the body.

97. Kinds of Nerves.—The nerves which grow from the brain and the spinal cord are of two kinds—nerves that carry messages *away* from the brain and the cord, and nerves that carry messages *to* the brain and the cord. Nerves that carry orders away from the brain are called *motor nerves* because the messages which they carry cause all the different motions of the body. The nerves that carry messages to the brain are called *sensory nerves* because the messages which they carry give rise to feelings or sensations.

Some of the cranial nerves are only motor; some, like the nerve of sight, are only sensory. Others are *mixed* nerves, that is, they have some motor fibers and some sensory fibers. They carry messages both ways. All of the spinal nerves are mixed nerves. The spinal nerves have two roots: one contains the motor fibers; the other, the sensory fibers.

98. The Cerebrum.—The brain consists of three parts—the cerebrum, the cerebellum, and the medulla oblongata (Fig. 16).

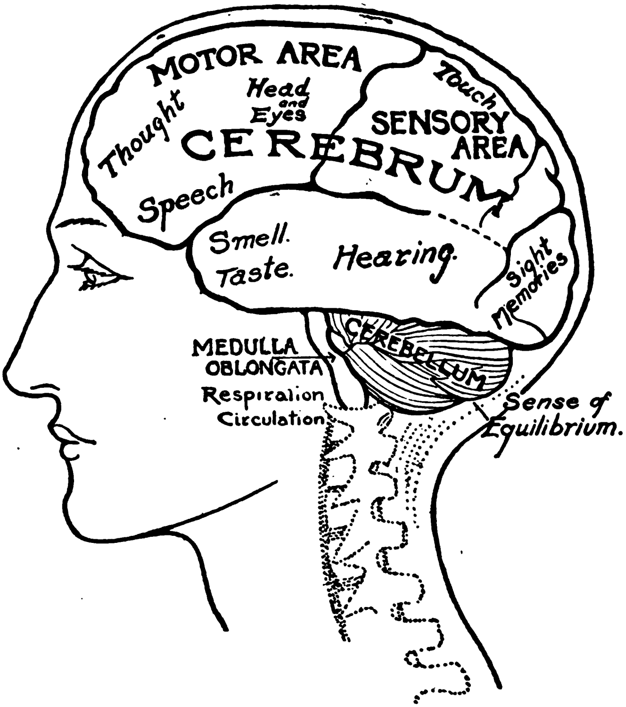

Fig. 16.—The brain.

The *cerebrum* makes up more than three-fourths of the entire brain. It occupies all the upper part of the skull above the level of the eyes and the ears. It is divided into two hemispheres, the right and the left, by a deep groove which runs through it from front to back. At the bottom of this groove is a thick broad band of white fibers which connects the two hemispheres.

The surface of the cerebrum is made up of curious folds or ridges called convolutions. The outside of the cerebrum is composed entirely of gray matter. The convolutions increase the surface of the brain and thus give more room for gray matter.

All the white matter of the cerebrum is on the inside. The white fibers which grow out of the gray cells on the surface of the cerebrum pass down through the medulla oblongata into the spinal cord. In the spinal cord they meet other nerve-cells from which fibers run to all parts of the body. In this way every part of the body is connected by nerve-fibers with the gray matter of the cerebrum.

The cerebrum is the part of the brain with which we think and feel. It is the part of the brain that we use when we see, hear, feel, taste, or smell. The cerebrum also controls all the voluntary muscles of the body. We speak of it as the seat of the mind because it is this part of the brain that is used whenever we speak or write, when we study, or remember, or reason, or use our will power—whenever we use our minds in any way.

99. The Cerebellum.—The cerebellum lies in the lower back part of the skull, just under the back part of the cerebrum (see Fig. 16). It is much smaller than the cerebrum, being only one-eighth of the entire brain. It has two hemispheres, like the cerebrum. The gray matter is on the outside and the white matter on the inside.

The use of the cerebellum is to keep all the voluntary muscles of the body working in harmony with each other. To understand the function of the cerebellum we must remember that hardly a single one of the thousands of movements we make every day requires the action of only one muscle. For some motions, like those of walking, writing, and eating, many muscles are needed; and it is necessary that these should all work together to produce the movements we wish to make. Making different muscles work together is called *co-ordination.* The cerebellum is the great center for the co-ordination of muscular movement. The cerebellum controls the muscles which keep our bodies balanced when we stand, walk, or run. It controls all complicated movements like dancing, skating, and swimming. In all voluntary movements the *cerebrum* is the commander-in-chief. All orders come from it, but the carrying out of these orders is left to the *cerebellum.* The cerebellum sees to it that the various muscles work together to produce the desired motion.

100. The Medulla Oblongata.—The medulla oblongata, often called simply the medulla or the bulb, is a little over 1 inch long and about as thick as a man's thumb. It lies just below the middle of the cerebrum, partly in front of and partly below the cerebellum (see Fig. 16). It connects the cerebrum and the cerebellum with the spinal cord. In the medulla the white matter is on the outside and the gray matter on the inside. The white matter is made up of fibers that come from the cerebrum and the cerebellum. One use of the medulla is to carry messages both downward and upward—from the brain and to it.

The medulla has another very important function. Inside the white matter are small clusters of gray matter. In these clusters of gray cells are the roots of the nerves that control respiration, circulation, and digestion. If these gray nerve centers in the medulla are injured, as sometimes happens when the skull is fractured, respiration and circulation may stop at once. The medulla is the part of the brain which controls the vital functions of the body.

101. The Sympathetic Nervous System.—Along the spinal column, lying just in front and on both sides of it, there are clusters or bunches of nerve-cells called *ganglia* (singular, *ganglion*). The ganglia are connected with each other by a cord of nerve-fibers. They are also connected with the spinal cord by small branches which run from the spinal nerves to the ganglia. Growing out from these ganglia are numerous nerve-fibers which go to all the internal organs and to all the involuntary muscles. The internal organs and the involuntary muscles are connected with the central nervous system in this indirect way. Though they are not under the control of the will, they work in harmony with the rest of the body or in "sympathy" with it. For this reason this arrangement of nerve-cells and nerve-fibers is called the *sympathetic nervous system* (Fig. 17). All of the vital functions which are not under the control of the will—respiration, circulation, digestion, gland secretion, and excretion—are controlled by the sympathetic nervous system and the medulla.

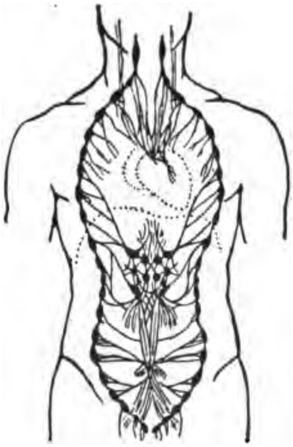

Fig. 17.—The sympathetic nervous system.

102. Motor and Sensory Areas of the Brain.—In the gray matter on the outside of the cerebrum there are special regions or "areas" for *receiving* messages from different parts of the body—an area for the feet, another for the legs, another for the hands, and so on. These are called the *sensory areas.*

Lying just beside the sensory areas there are similar areas for *sending out* messages to the same parts of the body. These are called the *motor areas* (see Fig. 16). There is a motor area which controls the muscles of the foot, an area which controls the movements of the hand, an area which governs the muscles used in speaking, and so on.

If the cells of the sensory region are injured we lose the sense of feeling in some part of the body. If the cells of a motor area are damaged we lose the power to move the part of the body that is controlled by that area. Thus, if an injury to the head has caused loss of feeling or loss of motion in some part of the body, the surgeon can tell exactly what part of the brain is affected.

An injury to the spinal cord may cut off some parts of the body from their connection with the brain. This also will cause loss of sensation or loss of motion, or both, depending upon the fibers of the cord that have been injured.

Loss of motion is called *paralysis*. A common cause of paralysis is the rupture of a blood-vessel in the brain and the forming of a blood-clot which presses on the motor cells.

103. Voluntary Action and Reflex Action.—Every muscle is supplied with a nerve, and the muscle contracts only when an impulse or a stimulus comes to it over this nerve. In all voluntary movements this impulse starts in the brain. It is carried down into the spinal cord by nerve-fibers which come from the brain. These fibers end in the spinal cord. Here the impulse is taken up by the nerve-cells of the spinal cord and is sent out to the muscles over a new set of fibers (Fig. 18). The nerve-cells of the spinal cord are a sort of relay station. They receive orders from the brain and send them out to the muscles over their own nerve-fibers.

Sometimes these nerve-cells in the spinal cord send out impulses to the muscles *without an order from the brain.* If you tickle the foot of a person who is asleep, he will pull it away. The impulse that makes the muscles contract does not come from the brain. The person does not even know that he has moved his foot. What happens is this: When you touch the person's foot, the sensory nerves carry a message upward to the spinal cord. When this message reaches the cord, it arouses or excites the nerve-cells of the cord and causes them to *send out* an order over the motor nerves which makes the muscles contract and pull the foot away. Movements of this kind are called *reflex acts* because the nerve impulse that is received over the sensory fibers is *reflected* or turned back again over the motor fibers (Fig. 19). The brain has nothing to do with such acts. Even

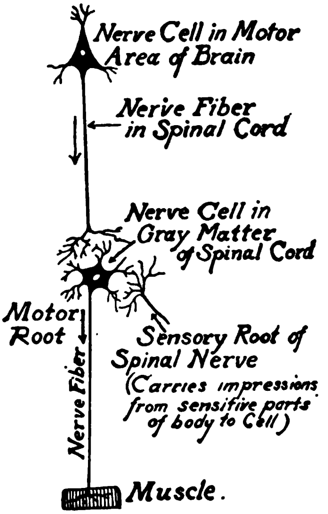
Nerve Cell in Motor Area of Brain
Nerve Fiber in Spinal Cord
Nerve Cell in Gray Matter of Spinal Cord
Motor Root
Nerve Fiber
Sensory Root of Spinal Nerve (Carries impressions from sensitive parts of body to Cell)
Muscle.

Fig. 18.—Path of the nerve message in voluntary movements.

if the person had been awake, he would still have pulled his foot away without stopping to think about it. Indeed, he could hardly help pulling it away. When the nerve-cells of the spinal cord are strongly stimulated, as in tickling, they will send out an impulse that will make the muscles contract, no matter how hard we try to prevent it.

104. Importance of Reflex Action.—Reflex action helps to protect the body from injury and saves the brain a great deal of work. If we always had to stop to think before we moved we would suffer many injuries that we now avoid. We dodge blows, pull our hands away from the hot stove, and jump out of the way of teams and cars before we have time to think. These, and many others like them, are reflex acts that help to protect the body from injury.

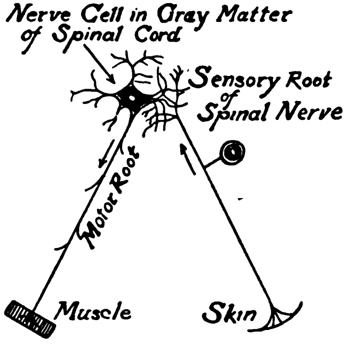
Nerve Cell in Gray Matter of Spinal Cord
Sensory Root of Spinal Nerve
Motor Root
Muscle
Skin

Fig. 19.—The path of the nerve message in reflex action.

When we first learn to write we must give our whole attention to every movement; but we soon learn to form the letters without stopping to think about their shape. Writing becomes a reflex act. All the acts that we perform again and again become reflex acts—dressing, eating, playing the piano, and so on.

In this way reflex action saves the brain an enormous amount of work.

105. Reflex Action of the Sympathetic Nervous System.—In a bright light the pupil of the eye becomes smaller. When the light is dim the pupil grows larger. When we see or smell something good to eat it often "makes the mouth water." When the body becomes too warm the blood-vessels in the skin dilate, the pores of the skin stand wide open, and the sweat-glands pour out more perspiration. This causes the body to lose heat rapidly and so regulates the temperature.

All of these things are brought about through the sympathetic system of nerves. They are *true reflex acts*. They all start with some message that is carried to the nerve centers by the sensory nerves. An order is sent back by the nerve centers over the motor nerves. All the involuntary processes of the body—digestion, circulation, respiration, gland secretion, excretion—are controlled and regulated in this way. The action of the sympathetic nervous system is entirely reflex. The control of the vital processes through the sympathetic nerves is one of the most important functions of the nervous system.

106. The Health of the Nervous System.—Since every part of our bodies is under the constant control of the nervous system, there is no other set of organs whose health is so important.

The things which have most to do with the health of the nervous system are those on which the health of the whole body depends. Proper food, plenty of fresh air and sunlight, outdoor exercise, and plenty of sleep—these are the things that make a healthy brain and a clear mind.

If we remember that one-eighth of all the blood in the body goes to the brain, we can understand why good food and pure air have so much to do with the health of the nervous system. Without these things we cannot have good blood, and without good blood we cannot have a healthy brain.

Just as the darkness of the night quiets and soothes the nervous system, so the sunlight seems to stimulate it and give it fresh strength and vigor. People who rarely get out in the sunshine usually are not so bright, cheerful, and energetic as those who get plenty of sunlight.

Outdoor exercise strengthens the heart and the lungs. It gives us better digestion, better blood, and better circulation. It improves the health of the nervous system because it makes the body more vigorous.

107. Relation Between the Mind and the Body.—"A sound mind in a sound body" is an old saying that was first used by a famous Latin author almost two thousand years ago. It is a splendid motto for all of us today. To have strong minds and to use our minds in the best way we must have healthy bodies. The mind cannot do its work well if the body is not well, for the body has a powerful influence on the mind. We cannot think clearly if the body is ailing in any way. When the body suffers the mind suffers also.

It is just as important, however, to understand the influence of the mind on the body, for there is no doubt that the mind has a powerful influence on many bodily functions, especially such vital processes as digestion and circulation. Strong emotions, like extreme joy, grief, and anger, interfere with these processes. Glands do not secrete properly, food is not digested, and the action of the heart and the blood-vessels is disturbed. In some cases very strong emotion has even caused death. Constant worry is sure to cause ill health. We should try to be always cheerful, to look on the bright side of everything, to hope for the best instead of dreading the worst, and especially not to worry.

108. Self-control.—To lose one's temper, to become so angry that one loses all control of himself, does a great deal of harm not only to the nervous system, but to the whole body. The body depends upon its nerve force to keep it going. No part of the body will do its work without the stimulation of the nervous system. The nerve centers can produce only a certain amount of nerve force every day. When we lose control of our feelings we waste an enormous amount of this nerve force. A fit of temper often uses up more nervous energy than is needed for a whole day's hard work. No one can hope to be really happy, healthy, or successful in life who does not learn self-control.

109. Headache.—Pain in any part of the body is a danger signal to warn us that something is wrong. If we cut or burn our fingers, wear shoes that are too tight, eat indigestible food, or abuse the nervous system in any way, the pain that follows is Nature's warning to be more careful.

Of all forms of pain, headache is the most common, because there are so many different things that may cause it. The most common causes are indigestion, constipation, eye-strain, worry, and breathing bad air. Persons who suffer much from headache should be careful of their diet, avoid constipation, and get plenty of fresh air. If the headaches are worse after reading or sewing, an oculist should be consulted. If one has frequent headaches it is best to consult a physician. Some of the diseases that cause headache are very serious, especially if they are not treated promptly.

Many people are in the habit of taking headache powders or tablets. This is a dangerous practice. Most of these headache cures contain powerful drugs which may do great harm to the heart. The use of these things causes a number of deaths every year. No medicine should ever be taken for headache or for any other pain except on the advice of one's own physician. For most headaches a few hours' sleep will do more good than any drug. A hot foot-bath will often relieve headache. One may try putting a cold cloth or a hot-water bottle to the head. The only way to *cure* headache is to find the *cause* and remove it.

110. Sleep.—Every part of the body must have time for rest. This is particularly true of the nervous system, because the nervous system produces the force which keeps all the other parts of the body at work. Even while we are asleep the spinal cord and some parts of the brain must continue to send out the nerve force which keeps the heart, the lungs, and other organs at work. It is only the mind which gets a complete rest.

While we are awake we are always using up nerve force faster than we are making it. During sleep the supply of nerve force is renewed, just as an electric storage battery may be re-charged after it has become exhausted. Without plenty of sleep the nervous system cannot do its work properly because it cannot maintain a sufficient supply of nerve force.

Sleep is necessary for the health of other parts of the body, especially the heart and the muscles. To get the full benefit from exercise we must have plenty of sleep, because it is during sleep that the muscles are repaired most rapidly. It is likely that children do most of their growing while they are asleep.

Grown people should sleep eight or nine hours every night. Children under twelve should have at least ten hours of sleep. Time spent in sleep is not wasted. Shortening the hours of sleep usually means shortening the years of one's life.

111. Time for Sleep.—The best time for sleep is at night. The darkness and the silence of the night have a soothing effect on the nerves and make sleep more restful. Those who are forced to work at night and sleep during the day hardly ever rest as well as those who can sleep at night. The employment of boys and girls at night should be forbidden by law.

There should be regular hours for sleep just as there are for meals. We can no more live without sleep than without eating, and it is just as important to take proper care about our rest as about our meals.

Some persons find themselves unable to sleep when they go to bed, particularly when they have been using their minds a great deal or when they are worried or excited. Regular hours for retiring and for rising, light exercise just before retiring, and plenty of fresh air in the bedroom will often overcome this trouble. Sometimes a warm bath in the evening or drinking a glass of warm milk will bring sleep when other things fail. Medicines to produce sleep must never be used without a doctor's orders.

112. The Sleeping-room.—The sleeping-room should be well ventilated at night, and the windows should be opened wide several hours during the day. No sleeping-room can be entirely satisfactory that does not get a few hours' sunshine each clear day.

Overcrowded sleeping-rooms are common, especially among the poor. In city tenements one may find an entire family of six to ten persons sleeping in one room, and this often the same room in which they live during the day. These conditions are a common cause of ill health. Not more than two persons should sleep in a room measuring 9 by 12 feet.

The bedroom should be furnished plainly. Carved furniture gathers dust and is hard to keep clean. Metal bedsteads are better than wooden ones. Heavy carpets, rugs, and draperies of all kinds should be avoided. They simply collect dust and disease germs.

Damp clothing that has been worn during the day should not be kept in the bedroom at night, nor should any of the clothing worn during the day be kept on at night. The bedding should be aired thoroughly every day if the weather permits. When we remember that most of us spend one-third of our lives asleep we can understand why we should make our bedrooms as healthful as possible.

113. Injuries to the Nervous System.—Injuries to the nervous system are often very serious. Even a slight blow on top of the head may cause unconsciousness and paralysis. Injuries at the base of the brain are almost always fatal. Injuries to the spinal cord frequently cause paralysis and death. It is because these injuries are so serious that we find the brain and the spinal cord so well protected by the bones of the skull and the spinal column.

The greatest care should be taken to avoid such injuries. Jumping or diving from a great height, putting one's head out of car windows, and running off the sidewalk into the street without looking out for teams and automobiles are some of the ways in which serious accidents occur.

The nervous system may be injured by extreme heat. Men who are exposed to the hot sun while they are working hard in summer, like farmers and soldiers on the march, may suffer from sunstroke. This may come on suddenly, the man falling over unconscious, or it may come on slowly, with pain in the head, dizziness, and gradual insensibility. It is often fatal. In cases that recover the mind is sometimes affected.

114. Habits.—Every one has noticed how much easier it is to do a thing the second or the third time than the first time. The oftener we do a thing the easier it becomes, until at last we can do it without even thinking about it. Indeed sometimes we cannot help doing it even when we try not to do it. The nervous system has acted in a certain way so often or so long that it is almost impossible to get it to act in any other way. When this occurs, we say we have "formed the habit" of doing some particular thing. Thus we form habits of eating, of drinking, of dressing, and so on.

The habits we form are among the most important things in our whole lives. They not only include such things as the way we walk, dress, and eat, but they control our manners, our conduct, our thinking—in fact, almost everything we do. Because habits are formed so easily and are so hard to break when once formed, we cannot be too careful about the things we do and the way we do them. Things we must learn to do should be done in the best way possible while we are learning them, so that the best way may become a habit. When lessons are to be prepared, we should give our entire attention to the task. To be able to do this is one of the most useful habits we can form. In our conduct we should be careful to avoid everything that we know is wrong, so that we may not form habits of disobedience, idleness, untruthfulness, or dishonesty. There are few things that have so much to do with our success in life as the habits we form in childhood.

No matter how careful we may be, all of us are sure to form some habits that are harmful and that we wish to get rid of. The best way to get rid of a bad habit is to form the opposite good habit by doing over and over again the thing we *ought* to do instead of the thing we have been doing. The longer we keep on doing a thing in the wrong way the harder it becomes to do it in the right way. Nothing is harder to overcome than a bad habit which has become thoroughly fixed. This is one reason it is so important to be careful of the habits we are forming.

115. Education and the Nervous System.—The cells and fibers of the nervous system are so small that they can be seen only with a powerful microscope. During the last few years the brain has been studied very carefully in this way, and it has been found that there is a great difference between the brain of an ignorant man and the brain of an educated man, although the two brains may look just alike.

The difference is not in the number of cells, but in the number of fibers. In other words, the brain of an ignorant man may have just as many cells as that of an educated man, but many of the cells have no fibers growing from them. Nerve-cells are of no use unless they have fibers which connect them with other cells. In the brain of the ignorant man there are many cells which have no fibers and which can do no work and are of no use. The brain cells of the educated man do have fibers which connect them with other cells. A careful study of many brains has shown that the more highly trained the mind is, the more of these connecting fibers there are.

Education consists in developing these connecting fibers. As with every other part of the body, these fibers are developed by *use* or *exercise*. Those who wish to have well-developed brains and well-trained minds must *use* their brains. They must observe carefully the things about them, they must read and study, and—most important of all—they must *think* and try to *express their thought*. Observing, studying, and thinking are the ways in which the connecting fibers of the brain cells are developed.

As with all other parts of the body, nearly all of the growth of the nervous system takes place *while we are young*. In uneducated persons very few new nerve-fibers are formed after they are twenty-five or thirty years old. In educated persons, however, they continue to grow even in old age, especially if they keep on studying and thinking. By far the largest part of them are formed during childhood. This is the reason it is so important to stick to our studies while we are young.

116. Effect of Alcohol on the Nervous System.—

The nervous system is made up of the most delicate cells in the body. The brain has an unusually rich blood supply, so that more alcohol is carried to it than to most of the other organs. For these reasons no other part of the body suffers so much from alcohol as the nervous system.

When a considerable quantity of alcohol is taken, the effect on the nervous system is divided into three stages. The first stage is one of *excitement*. The second stage is marked by *loss of control*. The third stage is that of *paralysis*.

First Stage.—Alcohol is absorbed very rapidly in the stomach. It reaches the nerve-cells of the brain in a few minutes. Its first effect is to excite the brain. The person becomes restless and talkative. His mind seems to work more rapidly and more easily than usual. He imagines he can think better and do more work after taking alcohol. Many tests have been made to see if this is true, and it has been proved that the brain really works more slowly and that a man does less work with alcohol than without it. It is the excitement produced by the alcohol that makes him feel as if he could think better and work faster.

Second Stage.—A small dose of alcohol may cause only slight excitement. Often no effect at all is noticed. If a considerable quantity is taken, the person soon begins to lose control of his actions. His speech becomes indistinct. He is dizzy. His hands tremble, and he staggers when he walks. He is unable to think clearly. His speech lacks sense. He loses the power of judgment, becomes reckless, and does things he would never think of doing if he were sober. Many crimes are committed by men in this condition.

The sensory regions of the brain are also affected. A drunken man often sees double. The sense of touch is dulled. He no longer feels the cold in winter. Hearing, smell, and taste are all diminished. He becomes dull and drowsy.

Third Stage.—If enough alcohol has been taken, the man finally becomes wholly unconscious. He falls into a drunken stupor from which he cannot be roused. All his voluntary muscles are completely paralyzed. The nerve centers in the medulla are the last to surrender. While these survive, he still breathes, his heart continues to beat, and the blood still circulates, although all of these are very weak. If the dose of alcohol is very large, even these centers are paralyzed, respiration stops, and the man dies.

117. Effect of the Prolonged Use of Alcohol.—The prolonged use of alcohol causes serious changes in the nervous system and in the mind. The worst of these is its effect on the person's will power. The drunkard loses all control of himself. His will becomes so feeble that he is no longer his own master. He becomes the slave of the terrible thirst for alcohol. He knows it is ruining his life, but he cannot leave it alone. He will sacrifice everything to satisfy his craving for liquor.

His brain becomes unable to do its work properly, even when he is sober. He loses control of his muscles. His hands tremble and he walks unsteadily, even when he has not been drinking. He loses the power to think clearly and to reason correctly. He is not fit to look after his business or to do any kind of work. Finally, in many cases, his mind breaks down entirely and he becomes insane. Alcohol is one of the most common causes of insanity.

Sometimes the excessive use of alcohol brings on a disease called delirium tremens. The drunkard becomes a raving maniac. He is tormented with all sorts of horrible sights and sensations. The attack often ends in death.

118. Alcohol and Heredity.—The saddest thing about the use of alcohol is its effect on the children of the drunkard. The children of drinking people often inherit a strong craving for liquor, and if they once taste it they are likely to become drunkards themselves. Their will power seems weak. They cannot resist temptation. Besides this, many a child has inherited a weak body or a weak mind from a drunken father. Idiots and epileptics are far more common among the children of drinking people than in the families of sober parents. A man may use strong drink all his life and not seem to suffer much himself, but too often his innocent children must pay the full penalty.

119. Effect of Tobacco on the Nervous System. —Tobacco has a very evil effect on the minds of young people. Boys who smoke cigarettes become nervous and irritable. They are hardly ever able to do the work that children of their age should do. In school they are often two or three grades below other children of the same age. Just as surely as a boy begins to smoke cigarettes he is cutting off his chances of ever making a real success of his life.

Tobacco, like alcohol, creates such a strong craving for itself that it is very hard to stop using it. Boys who begin to smoke cigarettes regularly hardly ever break themselves of the habit.

QUESTIONS

Why is the nervous system called the "master system" of the body?

Describe the gray matter and the white matter of the nervous system.

Explain the use of the nerve-cells and the nerve-fibers.

Name the parts of the central nervous system.

Describe the brain. What are its uses?

Describe the spinal cord and give its uses.

Describe the nerves and give their use.

Name the two kinds of nerves and explain the use of each.

Describe the cerebrum and explain its uses.

Describe the cerebellum. What is its use?

What is the medulla oblongata? Why is it such an important part of the nervous system?

Of what is the sympathetic nervous system composed? What is its use?

Tell what we mean by the motor and the sensory areas of the brain.

Explain how voluntary movements are produced. Why does a person who is asleep pull his foot away when it is tickled? What do we call this kind of action? Why is it given this name?

What are the uses of reflex action?

Explain how the sympathetic nervous system works. Why do strong emotions affect the heart and the stomach?

What things are most necessary to preserve the health of the nervous system? Give the reasons why each is necessary.

How does the condition of the body affect the mind? What effect do mental states have on the body?

Explain the importance of self-control.

Why may headache be called a useful pain? What are the common causes of headache? What simple remedies may be tried? Why should we avoid headache powders?

Explain why we must have plenty of sleep. How long should we sleep?

When should we sleep? Why?

Describe a satisfactory sleeping-room.

Explain the effects of injuries on the nervous system.

What do we mean by "forming a habit"? How are habits formed? Why are they important? Can you think of any bad habits that you have noticed in your friends or acquaintances? Do you know any of your own bad habits? Are you trying to get rid of them? How?

Explain why we should try to get as much schooling as we can while we are young.

Describe the effects of alcohol on the nervous system.

How does the prolonged use of alcohol affect the nervous system?

How may the children of drinking people suffer because of their parents' bad habits?

Explain the effect of tobacco on the nervous system.

CHAPTER VII

THE SPECIAL SENSES

120. The Special Senses.—The nerves that carry messages to the brain are called sensory nerves. Some of the sensory nerves, like the nerves of sight and of hearing, have *special organs* to receive impressions of a special kind which we can get only through these organs. We get impressions of light only through the eye and impressions of sound only through the ear. Seeing and hearing are called *special senses* because they require special organs which are fitted to receive special impressions. There are five special senses—touch, taste, smell, hearing, and seeing. All that we know of the world around us we must learn through these five senses.

121. Touch.—The sense of touch is located in the skin and in the mucous membrane of the mouth and nose. The nerves of touch end in little bulbs or "touch corpuscles" in the dermis or true skin. Anything that touches the epidermis presses upon these touch corpuscles, and the nerves of touch carry the impression to the brain. These nerves give us also sensations of temperature and of pain. Through the sense of touch we learn whether an object is rough or smooth, wet or dry, hot or cold, hard or soft. If it is small enough to be picked up, we learn its size and shape, and its weight. The weight of an object is estimated partly by its pressure upon the skin, but mainly by the amount of muscular force required to lift it.

The sense of touch is most delicate in the tips of the fingers, the tip of the tongue, and the lips. It may be developed to a wonderful degree. People who are blind may be trained to read raised letters with the tips of the fingers almost as readily as we read with our eyes.

122. Taste.—If you look closely at the tongue you notice that it is covered with numerous small elevations. These are called *papillæ*. They are much larger at the back of the tongue than at the tip. In these papillæ are little round bodies called taste-buds. The fibers of the nerves of taste end in these taste-buds.

When vinegar is placed on the tongue the nerves of taste carry a message from the taste-buds to the brain, and we get a sensation of sourness. Only liquids can make an impression on the taste-buds. Solid substances, like sugar, must be dissolved before they can be tasted. Insoluble bodies have no taste.

The chief use of the sense of taste is to guide us in the choice of food.

123. Smell.—The fibers of the olfactory nerve, or the nerve of smell, are spread out in the mucous membrane of the nose. The sense of smell warns us against bad air and bad food.

Taste and smell not only help to guide us in the choice of food, but they have something to do with its digestion. Food should be eaten slowly so that we may enjoy its taste and smell as much as possible. This increases the flow of the saliva and of the gastric juice, and the food is digested more easily and more thoroughly. Both taste and smell add greatly to the pleasures of life.

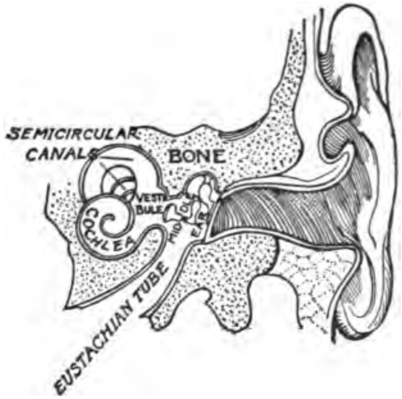

Fig. 20.—The ear.

124. The Ear.—The ear consists of three distinct parts—the outer ear, the middle ear, and the inner ear (Fig. 20).

The outer ear is made up of two parts, the shell of the ear and the canal. The shell is a plate of gristle or cartilage covered with skin and curiously folded to catch sounds. The shell is what we commonly speak of as "the ear." The canal is a tube about 1 inch long which leads to the middle ear. The inner end of this canal is entirely closed by a thin membrane which is stretched across it like the head of a drum. It is called the ear-drum or the drum membrane.

The middle ear is a cavity hollowed out in the temporal bone. The drum membrane separates it from the outer ear. The middle ear contains a chain of three tiny bones which stretch across it from the drum membrane to the inner ear. They are named, from their shape, the hammer, the anvil, and the stirrup. A short tube, called the Eustachian tube, leads from the middle ear to the upper part of the throat, or pharynx. This allows air to enter the middle ear and keeps the pressure of the air equal on both sides of the drum membrane.

The inner ear, or internal ear, like the middle ear, is hollowed out in the solid bone. It contains a small space called the vestibule. Opening out from the vestibule are three semicircular canals and a larger canal which, on account of its shape, is called the snail shell, or cochlea. The cochlea contains the fibers of the auditory nerve or the nerve of hearing. All the parts of the inner ear are connected with one another and are filled with a watery fluid. The semicircular canals have nothing to do with hearing. Their use is to help keep the body balanced when we sit, stand, or walk.

125. How We Hear.—Sound is carried to the ear by waves or vibrations of the air. These strike the drum membrane and cause it to vibrate. The vibrations are carried to the inner ear by the chain of bones, and from the inner ear the auditory nerve carries the impression to the brain.

126. Care of the Ear.—The ear is so well protected by the bones of the skull that it is not liable to injury if left alone, but great harm may be done by meddling with it, particularly by poking matchsticks, pins, and similar objects into it. All of these are likely to injure the drum membrane. If the ear wax which is secreted by the skin of the canal needs to be removed, it should be washed out gently with a cloth and warm water. A blow on the ear may break the drum membrane and cause deafness.

If shoe buttons, pebbles, peas, or other things get into the ear, they may sometimes be washed out by using a rubber bulb called an ear syringe and some warm water. This must be done very gently and should never be tried if the thing in the ear will swell when wet, like beans and peas. It is usually best to consult a physician at once when there is anything in the ear.

Most cases of deafness are caused by diseases of the nose and throat which affect the ear through the Eustachian tube. Many deaf children have adenoids (see Section 8), and removing the adenoids will usually help their hearing.

If there is any infection of the nose or throat, as in tonsillitis and diphtheria, it may spread to the middle ear through the Eustachian tube. If pus forms in the middle ear it may break through the drum membrane and produce a "running" ear. Running ears are dangerous. If they are not treated promptly they may cause meningitis or abscess of the brain.

127. Effect of Alcohol and Tobacco on the Ear.—Alcohol and tobacco affect the ear chiefly through the damage they do in the throat. Here they often set up an inflammation which closes the Eustachian tube or which may extend through the tube into the middle ear. In either case the sense of hearing is diminished. Cigarette smoking is especially likely to do this.

128. Importance of Sight.—Sight is by far the most important of the special senses. All of the other senses give us knowledge only of things that are within our reach or that are close to us, but through the sense of sight we learn about things that are far beyond our reach, some of them millions of miles away. We must get the greater part of our education through the eyes. Without sight it would be impossible for most of us to carry on our daily work. There is hardly any part of the body that is more useful or more necessary to us than our eyes.

129. The Eyeball and Its Protection.—The eyeball is a globe about 1 inch in diameter. The outer coat or covering is formed of a very strong, tough membrane which protects the delicate tissues within.

The eyes are set in deep bony sockets in the skull. The sockets are padded with fat which forms a soft cushion to protect the eyeball. The bones of the forehead, nose, and cheek protect the eye from blows. The eyelids cover the front of the eyeball. The eyelashes and eyebrows keep dirt out of the eyes.

In the upper and outer part of each socket is a small gland called the tear gland. It produces the tears and pours them out on the front of the eyeball to keep it moist and clear, and to wash away dust. The tears are drained off through a small canal or tube which leads from the inner edge of the eyelids into the nose.

130. The Cornea.—The tough white membrane which forms the outside of the eyeball has a round opening or window in front. Into this window there is fitted a round transparent plate called the *cornea.* The cornea is set into the front of the eyeball just like a glass crystal is set into a watch. It lets light through into the eye, just as a window lets light into a room.

131. The Iris and the Pupil.—A little behind the cornea is a round colored curtain with a little round hole in the center of it. The curtain is called the *iris*, and the hole in the curtain is the *pupil.* The pupil looks black because the inside of the eyeball is dark. The iris is the colored part of the eye.

The iris regulates the amount of light that enters the eye through the pupil. When the light is dim the opening or pupil becomes larger to let in more light. In a bright light the pupil becomes smaller to shut out some of the light.

132. The Lens.—Just behind the iris and the pupil is a round, transparent body called the *lens.* The lens acts just like the glass lens in a camera or in a magic lantern. It bends the rays of light that pass through it, so that whenever we look at any object a small picture or image of that object is formed at the back of the eyeball.

The lens is held in a ring of muscle. When this muscle contracts it changes the shape of the lens, making the front and back more bulging. When the muscle relaxes the lens becomes flatter. In this way the lens may be adjusted for objects near at hand or for those far away.

133. The Optic Nerve and the Retina.—The inside of the eyeball is lined at the back with a very delicate pink membrane which contains the fibers of the nerve of sight. This membrane is called the *retina.* All the nerve-fibers in the retina come together at the back of the eyeball to form the optic nerve, the nerve of sight, which connects the eye with the brain. The image which is formed by the lens falls on the retina, and the fibers of the optic nerve carry the impression to the brain.

134. The Coats and the Humors of the Eye.—The eyeball has three distinct layers or coats. The tough white membrane on the outside is called the *sclerotic coat,* or the *sclera.* The inner coat is the *retina.* Between the sclerotic coat and the retina is a dark-colored coat called the *choroid.* The choroid coat contains the blood-vessels which nourish the eye.

In the front of the eye each of these coats is changed in some way so that light may pass through into the eye. In place of the sclerotic coat we have the cornea. The iris and the pupil take the place of the choroid coat. The crystalline lens and its ring muscle (ciliary muscle) take the place of the retina (Fig. 21).

The cornea bulges a little more than the rest of the outer coat. Between the cornea and the crystalline lens is a small space filled with a watery fluid. This fluid is called the *aqueous humor.* Behind the lens is a large space which is filled with a transparent, jelly-like substance called the *vitreous humor.* In healthy eyes the cornea, the aqueous humor, the lens, and the vitreous humor are all perfectly transparent.

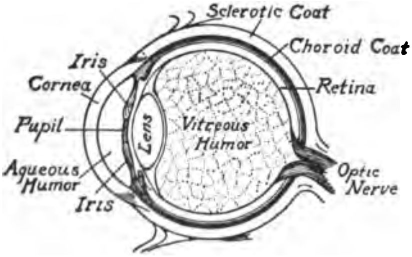

Fig. 21.—The eye.

135. How the Eye is Moved.—The eye can be turned in all directions by six very small muscles that are fastened to the outer coat of the eyeball (Fig. 22). When these muscles work properly, both eyes move in the same way, and both are turned toward the object at which we are looking. Sometimes one or two muscles are stronger than the others, or one of the muscles may be too short. In this case, only one eye can be kept straight; the other either turns out or in. The eyes are "crossed," and it is impossible to turn both of them toward the object at which the person is looking. Children who are cross-eyed should be taken to a skilled oculist before they are six years old, for at that time the condition can often be corrected without an operation. Cross-eyed children do not use both eyes at the same time. They really see with only one eye. If the condition is not corrected early, the sight of the other eye is lost from lack of use.

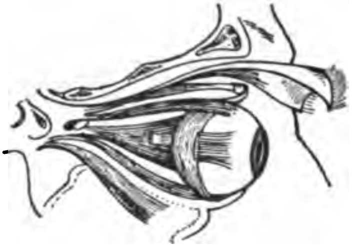

Fig. 22.—The muscles that move the eye.

136. How We See.—In many ways the eye is just like a camera. The cornea and the lens are like a double lens in a camera. The iris is like the diaphragm or "stop" in the camera which regulates the amount of light that passes through the lens. The retina is like the plate or the film on which the picture is taken.

When we look at an object, rays of light from that object pass through the cornea, the pupil, and the lens. The cornea and the lens act like the lens of a camera, and a little picture or image of the object is formed on the retina. From the retina the fibers of the optic nerve carry the impression to the brain, and we see.

137. Common Defects of Vision.—If the eyeball is properly formed a small but distinct picture is formed on the retina whenever we look at any object. In eyeballs that are not properly formed this image is not distinct, and it is impossible to see clearly or else it takes so much effort to do so that the eyes are soon tired out. There are three common defects of the eyeball. It may be too short, it may be too long, or the lens and the cornea may not have the right shape.

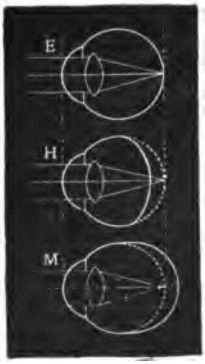

Fig. 23.—Defects of vision: *E*, Normal eye; *H*, far-sighted eye; *M*, near-sighted eye.

When the eyeball is too short the retina is too close to the lens. In this case objects close to the eye cannot be seen distinctly except with great effort. The muscle that changes the shape of the lens must work very hard to produce a clear picture on the retina. Objects at a distance can be seen much more easily; so people with this defect are said to be "far-sighted." This is the most common defect of the eye (Fig. 23).

When the eyeball is too long the retina is too far away from the lens. Objects at a distance can never be seen distinctly because the image is formed in front of the retina. To see any object clearly it must be held very close to the eye. Then the image is formed far enough behind the lens to fall on the retina. People who have this defect are said to be "near-sighted." This is the least common of these three defects of the eye.

The third common defect is called astigmatism. In astigmatism either the cornea or the lens is irregular in shape. If either of these is curved more in one direction than in another it is impossible to get a perfectly clear image on the retina. When vertical lines are clear, horizontal lines will appear double; and when horizontal lines are distinct, vertical lines look double (Fig. 24). In reading, the letters appear double or they run together. These eyes always tire quickly when doing close work. Astigmatism is almost as common as far-sightedness.

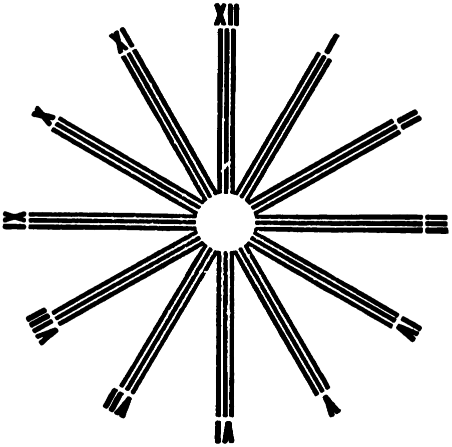

Fig. 24.—Test for astigmatism.

138. Correction of Errors of Vision.—All of the common errors of vision can be corrected by the use of proper glasses. To find out just what glasses are needed, the eyes should be examined by an oculist, that is, by a physician who has been specially trained to do this work, and not by an optician, whose business is to make glasses, but not to examine eyes. A great deal of harm is done by opticians and jewelers who attempt to examine eyes for glasses, especially in the case of children. It is not possible, in persons under forty-five years of age, to find out just what glasses are required unless the muscles of the eye are put at rest for a few days with "drops," and only a physician is allowed to use drops in examining eyes for glasses. Many opticians will not examine eyes for glasses.

139. Color-blindness.—A defect of the eye that is not very common but which may be serious is color-blindness. Some people cannot tell red from green. The two colors look just alike to them. This is the most common form of color-blindness. A few people cannot recognize colors at all. The cause of this condition is not known, and no way is known to correct it. Men who are color-blind cannot become railroad engineers or pilots on vessels because they cannot recognize the signals. The excessive use of tobacco sometimes causes color-blindness.

140. Eye-strain.—Most boys and girls know how a common magnifying glass or "burning glass" will bring rays of sunlight to a point. Perhaps you have set fire to a piece of paper in this way. The point at which all the rays come together is called the *focus*.

When the photographer takes a picture he moves the lens back and forth until the image at the back of the camera is distinct. If the picture is not clear it is not "in focus," that is, it is not at the proper distance from the lens.

When we look at an object the image on the retina must be in focus if we are to see distinctly. The eye must adjust itself for objects that are near at hand and for those that are far away, just as the camera must be adjusted. But in the eye focusing is done in a very different way. The lens cannot be moved backward and forward as in the camera. Instead of this, *the shape of the lens is changed.* The lens is held in a ring of muscle. When we look at things that are near, this muscle contracts and causes the lens to become more bulging, so that a distinct image may be formed on the retina. When we look at objects far away, the muscle relaxes and the lens becomes flatter.

If the eyeball is perfectly formed, objects at a distance can be seen clearly when the muscle is at rest. In such eyes it requires no effort at all to see distant objects clearly, and very little effort to adjust the eyes for objects 3 feet away. If the eyeball is too short the muscle must contract and change the shape of the lens even when we look at the most distant objects. In these short eyes the muscle must often work much harder to make distant objects clear than the muscles of perfect eyes have to work to give us a clear image of objects only 3 feet away. When such eyes are used for close work, like reading, writing, or sewing, the muscles that change the shape of the lens must work so hard that they soon become very tired and the eyes begin to ache. Then we have what is called *eye-strain.* The most common cause of eye-strain is far-sightedness, or an eyeball that is too short. Another common cause is astigmatism.

The most common effects of eye-strain are headache, pain in the eyes, and sore eyelids. In some cases it causes vomiting and indigestion. Neuralgia, sleeplessness, and nervousness are sometimes caused by eye-strain. Eye-strain is corrected by wearing suitable glasses. These relieve the muscle of the eye of all unnecessary work.

In old people the lens becomes so hard that the muscle can no longer change its shape to adjust the eye for near work. Most people become far-sighted after the age of forty, and must wear glasses for reading.

141. Importance of Wearing Proper Glasses.— Our sight is so precious that we cannot care for it too well. The eye is one of the most valuable organs of the body, and yet there is hardly any part of our bodies that we neglect and abuse so much.

The most important thing in caring for the eye is to wear glasses if they are needed. Savages do not need glasses because they cannot read or write. They do very little close work, and they are hardly ever near-sighted. Among civilized people, who must use their eyes constantly for all kinds of close work, glasses are often a necessity. To go without them when they are needed is just as foolish as it would be to use a tallow candle for reading when one might have an electric light.

A person with good sight should be able to read the letters in Fig. 25 at a distance of 20 feet. Children

Z P L R D F

Fig. 25.—Test type—20 feet.

who cannot do this should be taken to an oculist. This is a sure test for near-sightedness, but it is not a sure test for far-sightedness or astigmatism. Far-sighted children may be able to read these letters easily at 20 feet and still be in need of glasses because their eyes are strained when they use them for close work. For far-sightedness, unfortunately, there is no sure test that can be made without "drops." Every one under the age of fifteen should be able to see

every letter in the words of this line

distinctly if the page is held only 3½ inches from the eyes. Those who must hold it farther away are probably far-sighted. This distance gradually increases as we grow older. At the age of forty-five the test should be made at a distance of 12 inches. Headache and pain in the eyes after reading or writing are nearly always caused by eye-strain. Suitable glasses will give relief.

142. Proper Position in Reading.—In reading, writing, and sewing the head should be held erect or inclined forward only slightly. Bending over one's work causes an excessive flow of blood to the eyes which is very injurious. Instead of lowering the head to bring the eyes down to the work, the work should be brought up toward the eyes.

The direction of the light is important. The light should shine on the work, not on the eyes. In reading and writing the light should come from the left, especially in writing, so that the hand will not shade the work.

One should not read while lying down. It is impossible to get the book and the light just right. Turning the eyes down toward the book is very tiresome and injurious. Reading in cars is harmful because the book cannot be held perfectly still. The distance between the eyes and the book is constantly changing, and the eyes tire very quickly.

143. Good Light and Good Type.—The eyes should never be exposed to a very bright light. The retina is a very delicate structure, and a strong, glaring light has an injurious effect upon it. Looking at a dazzling light like the sun or even at a powerful electric light may do serious harm.

It is very injurious to work or to read in a dim light. An unsteady, flickering light is worse still. Nothing can be seen distinctly, and the strain on the eyes is very great. Moving-picture exhibitions may cause tired, aching eyes.

Books and papers with small type, and those whose pages have a glazed surface, are harmful. Type should be large and clear, the lines should not be over 4 inches long, and there should be plenty of space between the lines.

144. Resting the Eyes.—When we do any close work the shape of the lens must be changed to allow us to see distinctly. The muscle by which this is done is one of the smallest muscles in the body, and yet there is no muscle except the heart that must work so hard. To have strong, healthy eyes we must not use them too long for close work. The muscles must have a chance to rest. It is a good plan when one is doing any close work to drop the work for a few minutes now and then and to look at some object as far away as possible. This allows the muscle to relax and often gives great relief to tired, aching eyes.

145. Dirt in the Eye.—When a cinder gets into the eye it may be removed by holding the head erect with the eyeball turned downward. The upper lid is then easily turned back by holding a toothpick or the point of a pencil firmly against the upper part of the lid, grasping the eyelashes, and raising the lid with the other hand. The cinder will usually be found on the inside of the upper lid and is easily brushed off with a bit of cotton twisted on the end of a toothpick or with the corner of a clean handkerchief.

146. Sore Eyes.—Never rub the eye if there is dirt in it. Cinders may have sharp edges, and rubbing the eye will make them scratch the surface of the cornea. Your fingers always have bacteria on them, and if you rub these into the eye they may cause serious trouble.

Sore eyes are nearly always caused by germs which get under the eyelids. Dust, dirty towels in public wash-rooms, and public swimming pools help to spread these germs. *Never* use the towels in a public wash-room. Some of the most dangerous eye diseases may be caused by such towels.

The eyes sometimes become sore from cold winds, smoke, and dust. Bathing them with a solution of boric acid (boracic acid) will usually give prompt relief. Dissolve a teaspoonful of the powdered boric acid in a cupful of water, and bathe the eyes with this three or four times a day. If there is no improvement in twenty-four hours, a physician should be consulted. Other members of the family should not use the towels and washcloths used by any one who has sore eyes.

147. Effect of Alcohol and Tobacco on the Eyes.—Ordinary amounts of alcohol do not affect the eyes or the sight to any great extent. The long-continued use of strong drink often weakens the eyes and makes the sight poor. It sometimes causes a disease of the optic nerve which ends in blindness.

There are two kinds of alcohol in common use—grain alcohol and wood alcohol. The alcohol found in pure whisky, wine, or beer is all grain alcohol, although some of it is made from fruit instead of grain. Wood alcohol is entirely unfit to drink. It is a deadly poison to the optic nerve. Ignorant men sometimes use it with sugar and water to mix "home-made" whisky. Many men have lost their sight in this way. Wood alcohol is also used in making varnish. Painters sometimes go blind from using such varnish in a poorly ventilated room.

Tobacco smoke irritates the eyes. Nicotine sometimes causes blindness by destroying the optic nerve. There is a disease of the eyes in which the sight becomes very dim and foggy, and cannot be improved with glasses. Often there are large black spots in front of the eyes. Oculists believe that this is nearly always caused by tobacco or alcohol.

QUESTIONS

What are the special senses? Why are they called "special" senses? Why are they important?

Tell how we get sensations of touch. What are the uses of touch?

How do we get sensations of taste?

Where is the nerve of smell?

What are the uses of taste and smell?

Describe the ear.

Explain how we hear.

Explain fully the care of the ear. How is deafness usuall caused?

What is the effect of alcohol and tobacco on the ear?

Tell in your own words why sight is important.

Explain how the eyes are protected from injury.

What is the cornea and what is its use?

Explain the use of the iris and the pupil.

Where is the lens, and what is its use?

What is the retina? What is its use?

Describe the coats and the humors of the eye.

Explain how the eye is moved. Why should cross-eyed children be treated early?

Explain how we see.

Describe the common defects of the eyeball and tell how each affects the sight.

How are errors of vision corrected?

What is color-blindness? Why is it serious?

Explain what is meant by eye-strain. What is the cause of it? What are the most common effects of eye-strain? How is it corrected?

Explain why it is important to wear glasses if one's sight is defective.

How may the eyes be injured by bad positions in reading and writing? What is the correct position?

How do poor light and small type affect the eyes?

Why do the eyes need rest? Tell how we may rest them.

Tell how to remove a cinder from the eye. Show how it is done.

Tell what may cause sore eyes and what treatment may be used at home.

How do alcohol and tobacco affect the eyes?

CHAPTER VIII

EMERGENCIES

148. Importance of First Aid.—The first thing to do in every case of sudden illness or serious accident is to send at once for a physician. It is not always possible, however, to get a doctor promptly; and unless one knows what to do until the doctor comes the injured person may die. Many lives are lost in this way every year. In poisoning, suffocation, and severe bleeding something must be done *at once* if the person's life is to be saved, and every one should know what to do in these emergencies.

Many trifling injuries, for which no one thinks of sending for the doctor, may become serious if they are neglected or if they are not properly cared for. A little care and attention at the beginning may save a great deal of trouble later.

149. Wounds.—Wash the wound thoroughly, using warm water that has been boiled. After all dirt has been removed, wash out the wound with an antiseptic solution to destroy all germs and prevent blood-poisoning. Peroxide of hydrogen is good if it is fresh. Old solutions are worthless.

Cover the wound with a *clean* bandage and keep it covered until it has healed completely. Put on a clean bandage every day. Every household should have on hand a small supply of sterilized bandages for use in emergencies. *Never use old rags or cloths on wounds.* They always contain germs and they may cause serious blood-poisoning.

If the wound is deep, and you are not *sure* that *all* the dirt has been removed, consult a physician. Deep wounds that are not washed out thoroughly may cause lockjaw or blood-poisoning.

150. Bandages.—Never put an old, soiled bandage on a wound. Use nothing but fresh, sterilized bandages. They are not expensive, and they may help to prevent very serious trouble.

Bandages on the forearm and the hand will hold best if they are started at the wrist. Bandages on the leg should be started at the ankle. If the elbow, the knee, or the ankle and heel are to be bandaged, take first one or two turns above the joint, then one turn below the joint, one above, one below, and so on—making what is called a "figure-of-eight" bandage. This bandage is wide on one side of the joint and narrow on the other side, to allow the joint to bend. The narrow part, where the upper and lower turns cross, should be in front of the elbow, behind the knee, and in front of the ankle.

Place clean gauze or absorbent cotton on the wound before starting the bandage. Do not draw the bandage too tight. If the fingers or toes on the bandaged limb become cold and numb, loosen the bandage.

Slight wounds on the face, neck, or trunk may be covered with a pad of clean gauze held in place with strips of adhesive plaster. *Never cover up a wound with court-plaster.* If there are any poisons or germs in the wound, court-plaster keeps them from being washed out instead of draining them off, as absorbent cotton or gauze would do.

151. Burns.—Burns that are large or deep are always serious. A physician should be sent for at once.

One of the best remedies for ordinary burns is made by shaking together in a bottle equal parts of linseed oil and lime-water. Cover the burn with cotton or gauze wet with this mixture and put a loose bandage over it. Burns may be bathed frequently with a solution made by dissolving one-half cupful of baking soda (bicarbonate of soda) in 1 pint of warm water. Vaseline, olive oil, cold cream, or clean lard may be used to protect a burn from the air.

If a person's clothing is on fire one must act promptly. Throw water on him if it is at hand, but do not leave him to get it. The fire can be put out by shutting off all the air. Wrap the person in a heavy blanket, an overcoat, a rug, a table cloth, or anything else that you can get to keep the air from the flames. If you can find nothing, throw the person down and roll him over and over quickly. This will usually put out the flames and makes it less likely that any flame will be inhaled. A person whose clothing is on fire should not run. This only makes the fire burn faster.

152. Nose-bleed.—Hold the head erect. Apply cold water or ice to the nose and the back of the neck. In severe cases it is necessary to plug the bleeding nostril tightly with cotton. When this is done, make sure that blood is not flowing into the throat from the back of the nose. If the bleeding continues, send for a physician.

153. Fainting.—Lay the person flat on a couch or on the floor, with the head low to keep the brain well supplied with blood. Open the doors and windows to give him plenty of fresh air. Loosen the clothing about the neck and the waist. Rub the hands and the feet, and moisten the face with cold water. *Never dash water on the face or try to force anything down the throat of a person who is unconscious.* He may be choked to death. If he does not recover in a few minutes, send for a physician.

154. Choking.—Pieces of food, bones, buttons, and other objects that stick in the throat may cause death in a few minutes. Try to cause vomiting by putting a finger down the throat. A sharp blow on the back between the shoulders causes a sudden rush of air from the lungs that may be sufficient to dislodge the object. A small child should be held by the heels, head down, while several blows are struck on the back. Sometimes the object can be reached with the finger.

If coins, buttons, or pins are swallowed, one should not give purges. These cause excessive contraction of the intestines and increase the danger of injury. Large quantities of potatoes and bread should be given, to keep the bowel dilated and to form a coating about the foreign body that will allow it to pass through the intestines without doing any harm.

155. Excessive Bleeding.—Send for a physician at once if there is much bleeding from a wound. If a large vessel is cut, the person may bleed to death in a few minutes, so something must be done at once. Put a pad of gauze or of cloth over the wound and bandage it as tightly as you can. If the wound is on the arm or the leg, tie a handkerchief loosely about the limb above the cut, place a stick under the handkerchief, and twist it tight enough to stop the flow of blood in the arteries (Fig. 26).

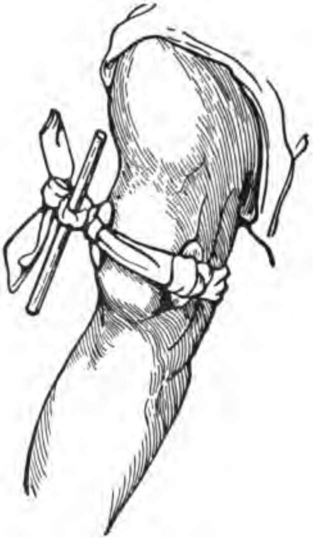

Fig. 26.—Tourniquet.

If much blood has been lost, or if the person is unconscious, he should be laid on his back, with the head lower than the body, so that the brain may get as much blood as possible. Tight bandages on the arms and the legs will help to force a larger supply of blood to the brain by decreasing the amount of blood in the limbs. The body must be kept warm.

156. Blows On the Head.—Lay the person flat on his back. Apply ice or cold cloths to the head. If he does not become conscious in a few minutes, send for a physician. Injuries to the skull or the brain may not produce any bad effects at once. The person may become unconscious some hours later. He should be taken home as soon as possible and watched carefully for several hours.

157. Fractures, Sprains, and Dislocations.—If a bone has been broken, it should be "set" by a physician as soon as possible, that is, the two ends should be brought together in their correct position so that the bone may have its right shape after it heals. If it is necessary to move the person before the bone can be set, a splint should be applied to the injured limb. This can be made from a narrow board, wrapped in cloth and padded, or a flat stick tied securely on each side of the limb will answer. The splint should be fastened to the limb with a bandage or with strips of cloth to keep the broken ends of the bone from moving and tearing the muscles, nerves, and blood-vessels. If there is any bleeding, this must be stopped first. The limb should be supported so that it will not hang down.

A sprain is an injury to a joint caused by a sudden twist or pull which stretches or tears the ligaments.

The injured joint must be kept at rest and bathed in water as hot as can be borne or wrapped in cloths wrung out of hot water. Severe sprains should be treated by a physician.

In a dislocation the end of a bone is forced so far out of its place at a joint that it does not slip back again. A strong, steady pull will often put the bone back in place. If this does not succeed, a physician should be consulted. After the bone is put back in place, the joint should be bandaged and kept at rest until it is perfectly well.

158. Dog-bites.—If one has been bitten by a dog or by any other animal the wound should be treated by a physician as soon as possible. If it is impossible to get a doctor quickly, open the wound well, wash it out thoroughly, and apply a little pure carbolic acid.

It is important to know if the dog is "mad," that is, if he has hydrophobia. To make sure of this, the dog should be taken to the health officers or to the nearest public hospital for a careful examination. If the dog has been killed, send the body. The Pasteur treatment is the only cure for hydrophobia. It must be given promptly.

159. Deep Wounds of the Foot.—These are frequently caused by stepping on nails. There is danger of lockjaw, especially if the wound is made in a stable or barnyard, or in a garden or field where there is fresh manure. Cleanse the wound thoroughly. Make sure you get *all* the dirt out of it. Wash it out thoroughly with peroxide of hydrogen.

160. Poisoning.—Most cases of poisoning are due to carelessness. Bottles and packages containing poison should be labeled plainly and locked up out of the reach of children. Poisons should never be kept where they may be taken for medicine by mistake. If cork stoppers are used, a few pins may be run through the cork to make sure these bottles will not be taken for medicine bottles even in the dark. In the case of poisons "an ounce of prevention" is worth *many* "pounds of cure."

If poison has been taken, the first thing to do is to send for a physician at once. But one must not remain idle until the doctor comes. With many poisons it is necessary to act *immediately* to save the person's life.

Two things should be done as soon as possible: First, *cause vomiting* to get rid of the poison before it is absorbed; second, give an *antidote*—something that will overcome the effects of the poison.

Anything that causes vomiting is called an *emetic.* In poisoning, one must use whatever is at hand—there is no time to send for anything. Whatever is to be done must be done *at once.* A tablespoonful of mustard in a glass of warm water, warm water and salt, warm soapsuds, or warm water alone may be used. If these do not cause vomiting promptly, tickle the back of the throat with the finger or with a feather.

These things should be repeated a number of times. The more warm water one can drink and vomit, the better the stomach will be washed out.

Poison labels usually have the antidote printed on them. Every one should know the antidote for a few of the most common poisons. One should remember, at least, that *it is always safe to give plenty of the white of eggs*. It is wise, especially where there are children, to keep in one's medicine cabinet a list of the common poisons, with the treatment for each.

Arsenic (Rough on Rats, Paris Green, colored papers).

Emetic.

Send at once to nearest druggist for *special antidote for arsenic.*

Give *magnesia* if it is at hand.

Carbolic Acid (Phenol).

Give large quantities of Epsom salts.

Alcohol is a good antidote. Give *dilute alcohol* or *whisky.*

Bichloride of Mercury (Corrosive Sublimate, Antiseptic Tablets).

Emetic. The best antidote is *albumen.* Large amounts of *white of eggs.*

Iodine.

Emetic. Large amounts of *starch* as an antidote.

Lead (Sugar of Lead, Lead-water, Goulard's Extract).

Emetic. *Epsom salts* is a good antidote.

Opium (Morphine, Laudanum, Paregoric, Codeine, Heroin, Soothing Syrups, and Cough Mixtures).

Emetic. *Hot black coffee. Keep the patient awake.*

Phosphorus (Match heads, some rat poisons).

Emetic. Give *peroxide of hydrogen* as an antidote.

Strychnine (Nux vomica, used in "Vermin-killers").

Emetic. Give strong tea or coffee.

Toadstools and Poisonous Berries.

Emetic.

Epsom salts. Castor oil.

161. Snake-bites.—The poisonous snakes of North America are the copperhead, the mocassin, and the rattlesnake. All of these have two fangs in the upper jaw. Their bite can be recognized by the two little holes they leave in the skin.

The important thing is to keep the poison from being carried throughout the body. If the bite is on the arm or the leg, tie a handkerchief or a cord about the limb above the bite and twist it tight enough with a stick to stop the circulation in the limb for a short time. With a sharp knife make a cut ½ inch deep and 1 inch long through the bite. Some one should suck the wound thoroughly, spitting out the blood. The poison will do no harm in the mouth unless there is a cut in the cheeks or the tongue. The wound should be cauterized ("burned") with pure nitric acid or carbolic acid or with a hot iron. Hunters do this by pouring gunpowder on the wound and setting fire to it or by laying a hot ember on the wound. One of the best remedies for snake-bites is permanganate of potash. The crystals themselves may be rubbed into the wound, or it may be washed out thoroughly with a saturated solution of the drug. The use of whisky in snake-bites is worse than useless.

162. Frost-bite.—If ears, fingers, or toes are frost-bitten, they must be thawed out *slowly* and *kept away from the heat* until this has been done. Rub the frozen part with snow or cold water until feeling returns and the circulation is restored. Then wrap it up in cotton.

163. Sunstroke and Heat Exhaustion.—Persons exposed to the heat of the sun on very hot days or to high temperatures in boiler rooms and factories may be affected in two ways. In *sunstroke* the person becomes *unconscious*, the face is *flushed*, the skin is *hot* and *dry*, and the temperature is very high. In these cases the body must be *cooled* as quickly as possible. Throw cold water on the neck and chest. Wrap the person in sheets wrung out of cold water. Place him in a bath of ice-water and rub his body with ice. Do not give alcohol.

In *heat exhaustion* the mind is dazed, but the person is *not unconscious*, the skin is *moist*, *pale*, and *cold*. The treatment for this condition is just the opposite of that for sunstroke, so it is important to know the difference between the two conditions. In heat exhaustion the patient should be covered with hot blankets. Give him hot drinks and stimulants, especially strong hot coffee.

164. Suffocation.—Suffocation may be caused by illuminating gas, by gas from a coal stove or a charcoal stove, or by gas in mines and old wells. Take the person at once into the open air. Loosen all the clothing and sprinkle the face and chest with cold water. If breathing is not restored, begin artificial respiration at once, as explained under Drowning.

165. Drowning.—Persons under water become unconscious and finally die for want of air. The heart continues to beat for some minutes after the person becomes unconscious. If the person is taken from the water during this time and breathing is started again, his life can be saved. Persons have been revived after being under water for fifteen minutes. Every one who goes swimming or rowing should know thoroughly some good method of artificial respiration. The method described below is generally considered the simplest and the best. If you expect to go swimming or rowing, practice this with one of your friends, so that you may know just what to do in case of accidents.

Turn the person over on his chest, with his face turned to one side so that the nose and the mouth are away from the ground (Fig. 27). Stand or kneel astride his body, facing the head. Place your hands, one on each side, over the small of the back. Now bend forward slowly, pressing on his chest, and so forcing the air out of his lungs. Then swing backward, taking your weight off his back. As you do this the chest resumes its shape and air is drawn into the lungs. Repeat these movements twelve to fifteen times a minute. As you swing backward and forward air is taken into his lungs and forced out of them just as if he were breathing naturally.

If there is some one to help you, wet clothing should be removed and warm blankets thrown over the body. Do not wait to do this if you are alone. Do not lose a moment. Begin artificial breathing *at once.* Remember that even a minute's delay may cost your friend's life. Do not give up too soon. It is usually necessary to keep up artificial respiration for one-half hour. In some cases recovery has taken place after it was kept up two or three hours. Keep it up at least two hours—longer if there seems to be any hope.

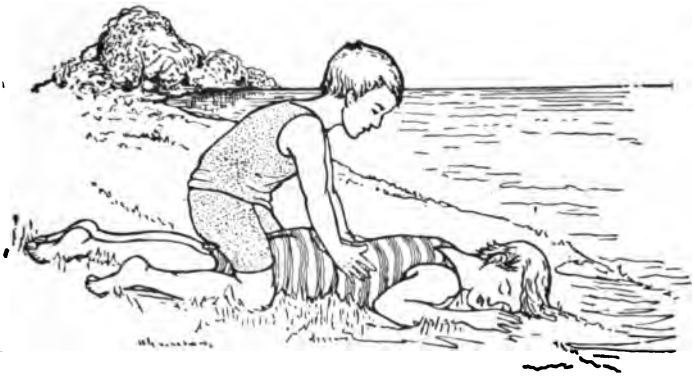

Fig. 27.—Artificial respiration.

QUESTIONS

Why is it important to know what to do in emergencies?

Tell what to do for slight cuts or wounds.

Give some simple rules for the use of bandages. Why should we not use court-plaster?

Tell what to do for burns. What should be done if a person's clothing is on fire? Why?

How would you try to stop nose-bleed?

Tell what to do for a person who has fainted.

How may a person who is choking be helped?

How may excessive bleeding from a wound be checked?

What should be done if a person has been struck on the head?

Tell what to do if a bone is broken. What may be done for sprains? For dislocations?

Describe the treatment for dog-bites. What should be done with the dog? Why?

How should deep wounds of the foot be treated? What is the special danger in wounds of this kind?

How may poisoning be avoided? What things must be done if a person has taken poison? Name three things that may be used as emetics.

Name a few of the most common poisons and the antidote for each.

Tell what to do for snake-bites.

How should frost-bite be treated?

How could you tell whether a person was suffering from sunstroke or heat exhaustion? Describe the treatment for each condition.

Show how you would try to revive some one who had been taken from the water unconscious.

CHAPTER IX

PUBLIC HYGIENE

166. Importance of Public Health Work.—Many of the things on which our health depends are things that each of us must attend to himself. Each person must guard his own health in such matters as eating and drinking, outdoor exercise, cleanliness, rest, and sleep. These things are a part of *personal hygiene*.

It is not possible, however, for any person to guard himself against *all* of the things that may affect his health unless he lives entirely alone and never has any dealings with anyone else. No matter how careful he may be himself, he cannot protect his health against the ignorance or carelessness of others, especially if he lives in the city. The milk he drinks may have come from diseased cows and his drinking-water may be full of typhoid germs. The stranger who sits down beside him in the car may be carrying the germs of smallpox or scarlet fever. The air he breathes may be full of dust, smoke, or foul odors. To guard ourselves against these things we must all work together. No one can do it alone. To protect our health in matters like these requires the united action of the whole community—the whole group of people who live together in a town or city. In other words, these things must be attended to by our government—some of them by our city or county government, some by the state government, and some by the United States Government. These things are a part of *public hygiene.*

It is only in recent years that we have come to understand how important and how necessary it is for the government to care for the health of the people. For a long time it was thought that the principal business of the government was to maintain order and to punish crime. But today our city and state governments spend much more money for the education and the health of the people than for keeping down disorder. To guard the health of the people is now considered one of the highest duties of the government.

167. What Public Health Work Includes.—One of the most important duties of the government is to see that we get *pure food*, *pure water*, and *pure air*. These are the daily necessities of life. Laws concerning pure food and food inspection are made by our national government, our state governments, and our city governments. The water-supply is a problem that each city must solve for itself. In many parts of our country there are state laws to prevent the pollution of rivers and smaller streams. All of our large cities help to keep the air pure by cleaning the streets regularly. Many cities have smoke inspectors who see that the air is not made impure by smoke and gases.

Another very important duty of the government, especially in large cities, is the *removal of waste.* Streets must be kept clean. Sewage must be disposed of. Garbage, ashes, and other household waste must be collected and removed.

A third important part of public health work is the *prevention of contagious diseases.* This is done through *medical inspection*, *quarantine*, and *disinfection.*

Besides medical inspectors and food inspectors, we have factory inspectors and tenement house inspectors, whose duty it is to see that people are not exposed to any unnecessary dangers in their workrooms and in their dwellings. There are Boards of Health which have many duties. In all progressive towns and cities there are parks and playgrounds whose chief purpose is to help people to keep well. And for those who have fallen ill there are everywhere in our cities hospitals and sanitariums where they may be treated and cured.

PURE FOOD AS A PUBLIC HEALTH PROBLEM

168. Adulteration of Food.—When your mother wishes to make a rich cake she uses plenty of butter and eggs. These things are expensive, especially during the winter months. The baker who sells a large number of cakes must pay a great deal of money for the eggs he uses. If he is dishonest he may make his cakes without eggs. By coloring them with a dye which he can buy for that purpose he makes them *look* as if they were made with eggs. Or he may use eggs that are so bad that they are not fit for food —"rots and spots" the dealers call them. Such food is not fit to eat. It is impure because it is *adulterated.*

There are many ways of adulterating food. All of them are dishonest and many of them are injurious to health. Water is added to milk. Cotton-seed oil is sold as olive oil. Coffee is adulterated with chicory and ground peas. Oleomargarine is sold as butter. Candy is often colored with poisonous dyes. Cheap candies are often coated with shellac—a kind of varnish—to make them look shiny. Ground spices are adulterated with cocoanut shells and ashes. Copper sulphate is used to give a green color to pickles and to canned peas. Benzoate of soda is sometimes used in making catsup of rotten tomatoes. Formaldehyde is added to milk to keep it from turning sour. Other chemicals are used to make spoiled meat look bright red and fresh. All of these things are unlawful.

169. Careless Handling of Food.—The farmer who raises nearly everything that he eats can easily make sure that his food is pure. Those who live in cities and buy all their food cannot always tell what has been mixed with it or how it has been handled.

Food may become impure by careless handling as well as by adulteration.

Food that has been exposed to the dust of the street cannot be clean and pure. Milk that is dipped out of open cans on the street or in stores is almost sure to be dirty and unfit for food. Fresh meat is often hauled for long distances through the city streets in open wagons, uncovered. Bread may be baked in filthy basements and peddled from door to door with unclean hands. Careless grocers may keep cornmeal, oatmeal, dried fruit, and other foods in open bins where they are sure to become dirty. Flies very often carry disease germs, and food that is exposed to flies is not safe.

In most of our cities there are laws forbidding such careless handling of food, but it is very difficult to see that everybody obeys these laws. The housewife who buys the food of the family should see for herself, as far as she can, how the food is handled. She should refuse to deal at any store that is not kept clean and spotless, and she should never buy any food that she knows has been exposed to dust or to flies. In buying food the rule should always be "safety first," and each buyer should be her own inspector as far as possible.

170. Why Food Spoils.—Nearly all animal and vegetable matter furnishes food for some kind of bacteria, and when such bacteria grow in it they cause it to decay. When food spoils it is because bacteria are growing in it. If we could keep bacteria out of it or prevent their growing in it it would not decay.

Food that has begun to decay is not fit to eat. It may be very dangerous. The bacteria that cause food to decay sometimes produce deadly poisons called ptomains. Meat, milk and milk products, shell-fish, and fish are especially likely to contain ptomains if they are not fresh. Canned goods that are not air-tight may also contain them. These poisons are not destroyed by boiling. The bacteria that produced the poisons are killed, but the poisons remain. Tainted food cannot be made fit to eat by boiling it.

171. Care of Food.—The one thing that must always be kept in mind in handling food is *cleanliness*. All unclean food is dangerous food. To keep food clean and pure it should be handled as little as possible, and then only with hands that are *absolutely clean.* It must be kept only in clean places and sold only in stores that are perfectly clean. It must never be exposed to dust or to flies. Milk should be sold only in bottles, and these should be thoroughly washed and sterilized before being used again. Bread should never be sold unwrapped. Sugar, cereals, dried fruit, and as many other foods as possible should be sold only in sealed packages. To be careless in these matters is to invite disease. (See also Sections 74 and 77.)

172. Preservation of Food.—All that is necessary to keep food from spoiling is to prevent the growth of bacteria in it. This may be done by keeping it at a low temperature in refrigerators and in cold-storage warehouses. Bacteria are destroyed by high temperatures. Food that is thoroughly boiled and then packed in air-tight cans will keep a long time. The growth of bacteria is prevented by strong solutions of salt (brine). Pork, beef, fish, and pickles are preserved in brine. Bacteria cannot grow without moisture. Food that is thoroughly dried and kept dry does not decay. Meat, fruit, and vegetables are preserved in this way. (See also Section 75.)

Food that has been preserved with salt or by drying it is usually less wholesome and less nourishing than food that has been canned or kept in cold storage. In our large cities the cold storage of food has become a necessity. The quantity of food used is so great, it is brought from such long distances, and so much time is needed to distribute it to stores and families that such foods as milk, meat, eggs, and fish could not be kept fresh without cold storage. Meat and fish are carried for hundreds of miles in refrigerator cars and are kept in cold-storage warehouses until they are to be used. With proper care they will remain fresh and good for months. In many places the handling and the sale of cold-storage foods are regulated by law.

173. Pure Food Laws and Food Inspection.— Nearly all of the cities and states of our country have laws which are known as Pure Food Laws. The chief purpose of these laws is to prevent the sale of food which is impure and injurious to health. Our national Congress has passed laws which forbid the shipment of such food from one state to another. In the large packing houses at Chicago, Omaha, and Kansas City the government has inspectors who examine every animal whose flesh is to be shipped to other states. Your butcher can show you how such meat is marked by these inspectors. Most of our large cities have their own inspectors to examine meats dressed in the city. (See Section 76.)

Another purpose of the Pure Food Laws is to prevent fraud in the sale of food. There is nothing harmful in oleomargarine. It is a good and wholesome food, but it is dishonest and unlawful to sell colored oleomargarine, or "butterine," as butter. Apple jelly is just as wholesome as grape jelly, but it is wrong to flavor it and sell it as grape jelly. Pure Food Laws often require that all packages of food that are offered for sale must have a label showing exactly what they contain, so that people may know just what they are buying.

174. Pure Water as a Public Health Problem.— If our drinking-water is not pure it may be the cause of some of the most serious diseases. Typhoid fever, cholera, and dysentery are often caused by polluted water, and yet such water may seem perfectly clear and good. It is the duty of the government to guard the water supply of the people. In most places the state health officers will make a careful examination of the water of any well or stream, if they are asked to do so, to see if it is safe for drinking. They post warning notices at all wells and springs that are found to be polluted. The state should protect the water supply of all its towns and cities by forbidding the pollution of streams with sewage. The city government must provide an ample supply of water, and it must make sure that the water is pure. How this is done is explained in Chapter V, Sections 85 to 89.

175. Pure Air as a Public Health Problem.— We have already learned how important it is to breathe pure air and how we can get fresh air in our homes, schools, and workshops by means of proper ventilation (Chapter I, Sections 11 to 13). Many of our large cities have laws which fix the quantity of air-space that must be allowed for each person in tenements, and which require such buildings to be properly ventilated. But the best ventilation is useless if the outside air is impure, and it is the duty of the city government to see that the air does not become unfit to breathe.

There are many ways in which the outside air may become impure. In the country, manure piles, pig pens, and heaps of decaying garbage are common causes of impure air. In the city the two most common causes of air pollution are unclean streets and factory smoke and gases. The remedy for each of these conditions is plain. Clean streets mean purer air and better health. Manufacturing plants should have tall chimneys through which smoke and gases may be discharged into the atmosphere at a height great enough to avoid polluting the air we breathe. Smoke is a nuisance which is largely unnecessary.

176. Sewer Gas.—The air of sewers is always very impure. The same pipes that carry sewage and waste water from our homes into the sewer would also carry sewer gas into our homes if modern plumbing did not prevent it. This is done by means of "traps" (Fig. 28). The trap is always filled with water so that no gas can pass from the sewer into the house. There is a large trap in the main drain of the house, and each of the smaller drain pipes has its own separate trap. The main drain pipe should extend up above the roof and should be open at the upper end so that any gas that may rise from the water in the traps may escape through this vent.

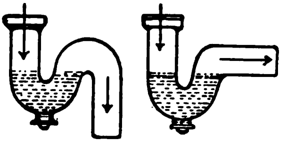

Fig. 28.—Sewer trap.

The greatest care should be taken to have all joints in the plumbing perfectly tight. Leaking joints should never be neglected, but should be repaired at once. Water and drain pipes were formerly placed within the walls of the house. The modern method of "open plumbing," by which all pipes are run where they are easy to get at, is much better. In cities the *building laws* require all plumbing to be constructed in a proper manner.

HYGIENE OF OCCUPATION

177. Occupation and Health.—One of the most important things that young people have to do is to select the occupation they will follow. There are few things that have so much to do with one's happiness and success in life as the wise choice of an occupation. In choosing an occupation one of the things to which little or no thought is usually given is the effect that the occupation may have on health. Yet it is well known that some occupations are dangerous, that some are injurious to health, and that others seem to promote good health.

The most healthful occupations seem to be those which are carried on outdoors, in the open air, even if the worker is sometimes exposed to cold and to dampness. All records seem to prove that outdoor workers, like gardeners, farmers, and drivers, live longer than those who work indoors.

In some occupations the worker is exposed to dangers which cannot be entirely avoided. Miners, sailors, railroad men, iron workers who put up the framework of our city "sky-scrapers," and powder-makers must take some risks which men of other trades avoid. In most states the laws require the employer to provide safety appliances which help to make these trades less dangerous.

Many trades are considered unhealthful, but most of the dangers to health that are met in these trades can be avoided. With proper care most of these occupations can be made safe enough. It is important for young people to know what the most common dangers are and how they may be avoided.

178. Poisons Make Occupations Dangerous.—In many trades it is necessary to use substances which are poisonous when taken into the body. The handling of these poisons is always dangerous unless great care is used. All occupations that require the handling of poisons are dangerous to health unless every precaution is taken to prevent taking the poison into the body.

The substances which most frequently cause poisoning through their use in the trades are *lead*, *phosphorus*, *mercury*, and *arsenic*.

Lead is by far the most common poison to which workmen are exposed. It is used in many trades. Painters and plumbers handle it constantly. It is used in the manufacture of glass, china, and earthenware, in making artificial flowers, leaves and jewels, in glass-cutting and polishing, in file-cutting, in dyeing, and in the glazing of many kinds of paper. Type-founders, type-setters, and printers are all exposed to lead-poisoning. A form of lead is used to give weight to certain kinds of lace and silk, and garment makers who handle these goods may be poisoned. Lead-poisoning is common among men engaged in making storage batteries.

There are several ways in which lead may cause poisoning. It may be inhaled in the form of dust, or it may be carried into the mouth with unclean hands. In some cases it may be absorbed through the skin. Wherever lead is used in any form perfect ventilation should be provided. Dust should be done away with as far as possible. The hands should be kept clean. It is especially important to wash the hands and face thoroughly before eating.

The inhalation of the dust may be prevented by the use of suitable masks, or "respirators," but it is hard to get workers to use them. Poisoning in the trades is very often the fault of the worker rather than the fault of the employer. The law often compels the employer to provide means by which poisoning may be avoided, but too often the workers will not use the things provided.

White lead is made from ordinary lead. It is used in nearly all paints. It is this that makes painters liable to lead-poisoning. Men who work in paint factories must be especially careful.

Phosphorus is used in making matches. Common phosphorus gives off fumes which are very poisonous. In severe cases of phosphorus-poisoning the whole of the lower jawbone may be eaten away. Persons with decayed teeth should never work with phosphorus. Wherever phosphorus is used there should be thorough ventilation to carry off the fumes. Many cases of phosphorus-poisoning are caused by the workers' own carelessness and lack of cleanliness.

Matches can now be made from a form of phosphorus which is not poisonous. In some of the European countries the use of the poisonous white or yellow phosphorus is forbidden by law. The Congress of the United States has recently passed a law placing a very high tax on the poisonous yellow phosphorus, so that the red phosphorus, which is not poisonous, would be used instead.

Mercury is much less dangerous to handle than phosphorus, but it is used in many more trades. Mercury is used in making mirrors, thermometers, barometers, certain kinds of electric batteries, and in bronzing, silvering, and gilding plaster casts and other objects. Most cases of mercury-poisoning occur among the makers of felt hats. The hair and fur from which felt is made are treated with a form of mercury. The felt is afterward heated until the mercury is vaporized and driven off. In this form it is inhaled by those who are engaged in the work. Those who work with mercury should wear masks to avoid inhaling the fumes. Workrooms should be thoroughly ventilated and hands and clothing kept as clean as possible.

Arsenic is a very dangerous poison. In the form of Paris Green or arsenate of lead it is often used to destroy insects on plants. Most rat poisons contain arsenic. Many of the green paints and dyes are made of arsenic. Dyes containing arsenic are used in printing wall-papers and cotton goods and in making artificial flowers. White arsenic is much used in curing furs. Workers in fur may be poisoned by it.

Alcohol and *tobacco* are both poisons. They often injure the health of those who work with them. Wood alcohol is much used in making varnishes and cheap toilet preparations, and these things may cause fatal poisoning. The fumes of wood alcohol sometimes cause total blindness.

179. Irritating and Poisonous Gases.—When workers are poisoned by phosphorus and mercury it is usually because they have inhaled the *fumes* of these substances. These two are the most important of the poisonous vapors to which men are exposed in the trades, but there are many others. Carbon monoxide, a very poisonous gas, is often given off from coke ovens, iron furnaces, lime-kilns, and charcoal heaters. In cellars or vaults where fermenting liquors are stored carbon dioxide may be produced in deadly quantities. Workers in rubber factories are often exposed to the fumes of naphtha and similar fluids. These fluids are also used in cleaning woolen clothing and other goods that cannot be washed. Those who work in establishments where this work is carried on are often poisoned by the fumes of these liquids. Other processes in which irritating or poisonous gases are given off are the making and using of bleaching powders, the galvanizing of iron, and the making of brass castings. Nearly all brass founders suffer sooner or later from "brass-founders' ague." Painters are sometimes poisoned by the fumes of wood alcohol from cheap varnishes which are used for inside work.

There are many manufacturing processes which cannot be carried on without producing dangerous gases. In all such cases the health of the workers should be protected by providing hoods and flues with forced draft, so that all gases and fumes may be carried away. Respirators, or dust-masks, should be provided so that workers may not be injured by breathing dangerous gases or inhaling dust (Fig. 29). No one who values his health should continue to work where he is exposed to irritating gases or fumes.

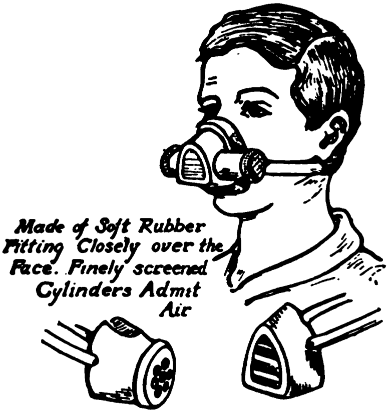
Made of Soft Rubber Fitting Closely over the Face. Finely screened Cylinders Admit Air

Fig. 29.—Dust-masks.

180. Dust.—The greatest enemy of the workman is *dust*. Of all the dangerous things connected with the various trades and occupations, dust is the worst. It is by far the most common cause of ill health among workmen. Nearly all of this sickness is unnecessary. It could be prevented if employers were willing to spend the money necessary to make their shops sanitary and if workmen were willing to take the precautions necessary to avoid taking dust into their lungs.

"The principal trades and occupations in which excessive amounts of dust are found are: all forms of grinding and many processes of polishing and cleaning; the textile industries; in the lead, copper, and iron trades irritating and poisonous dusts are raised; also in pottery works and masonry, and in the handling of leather, skins, feathers, wool, cotton, wood, paper, and tobacco." *

Dust may be harmful because it is poisonous. The most important of the poisonous dusts are lead and arsenic. The trades in which these substances are used have already been named (see Section 178).

A far more common way in which dust causes disease is by *irritating* the lining of the air-passages and the lungs. The first effect is to produce a cough, which becomes chronic. The lungs are weakened. If the germs of tuberculosis get into these lungs—and all of us are sure to take some of them into our lungs now and then—they grow very rapidly because the weakened lungs are unable to resist them. Consumption is very common in all the dusty trades. There are fifteen times as many deaths per thousand among men who work in stone-dust (marble-cutters, granite workers, etc.) as there are among men whose trades are not dusty. Coal mining is one of the most unhealthful of all occupations. Metallic dust is almost as injurious as stone-dust. Worst of all is the mixture of stone-dust and metal-dust which is produced in all forms of metal grinding. In the cutlery works of Sheffield consumption is called "grinder's rot," because nearly all grinders die of it.

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* Rosenau's Preventive Medicine and Hygiene.

Next to metal grinding, the textile industries are the worst of the dusty occupations. "Among the most unhealthy classes of work-people are those engaged in cotton and linen factories." Cotton dust is very irritating and injurious to the air-passages. Consumption is very common among workers in cotton and linen mills. Of the workers in the linen factories of Belfast more than twice as many die of consumption as of all other diseases.

Besides being poisonous or irritating, dust may be harmful because it carries disease germs. Paper makers sometimes take contagious disease from infected rags. Anthrax, or "woolsorters' disease," is often acquired from infected horsehair, wool, and hides. All raw material of this kind should be thoroughly disinfected before it is handled.

Much of the dust in factories and workshops is unnecessary. Improved machinery and better methods of manufacture will do away with much of it. Wet grinding can be used instead of dry grinding. Dusty operations can often be carried on in enclosed hoods or cabinets so that the workers are protected from the dust, or the dust can be carried away by suction fans. Good ventilation diminishes the danger very much. Oiled floors hold the dust that drops on them and prevent its flying about in the air. When workmen must stay in a dusty atmosphere, they should wear respirators to avoid inhaling the dust, even if these are uncomfortable.

181. The Workroom.—The three greatest needs of workshops, factories, and stores are *fresh air*, *cleanliness*, and *daylight*. A constant supply of fresh air is far more necessary in most factories than in dwellings, for in factories the air not only becomes impure by being breathed over and over again, but it is very often made more impure by the work that is being done. Without fresh air the workers are doubly poisoned—first, by their own breaths, and second, by the dust and the gases that may be produced by their work.

Lack of cleanliness is very common in workshops. The dirty workroom is an unhealthy workroom. Not only should the floor and the walls of all workrooms be kept perfectly clean, but the workman himself should be clean. There should be plenty of washstands. Many up-to-date factories have shower-baths for the use of the workers. Employers find that it pays to provide these things, for the healthy workman accomplishes more than the man who is weakened by bad air and by lack of cleanliness.

The *lighting* of the workroom has much to do with the safety and the health of the workman. In recent years there has been a wonderful change in the lighting of factories. In the most modern factories the walls seem to be all windows. Every effort is made to get just as much daylight on each floor as possible. The workmen can do more work and better work, there is much less risk of accidents, and the workmen are healthier.

182. Hours of Labor.—In many of the lighter trades workmen formerly were often employed fifteen or sixteen hours a day. It is not strange that their average length of life was only thirty years. To keep well the worker must have sufficient time for rest and some time for recreation. Practically all skilled workers now insist on dividing the day into three equal parts—"eight hours for work, eight hours for play, and eight hours for sleep." Even unskilled laborers usually do not work more than ten hours a day. Besides the daily period of rest, it is important to have one full day's rest each week. The Saturday half-holidays during the summer and the vacation period which many employers give their workmen show how much more the health of workers is considered now than formerly.

183. Employment of Women and Children.—Many of the occupations that are injurious to health or that require long hours of labor are particularly injurious to women and to growing boys and girls. Nearly all civilized countries have laws which protect the health of these workers by fixing the number of hours that they may be employed and by forbidding their employment in the trades that are most dangerous to health. In Pennsylvania the law forbids the employment of children under sixteen unless they have finished the Sixth Grade, are fourteen years old, and have passed a satisfactory physical examination. They may not work more than fifty-one hours a week and eight hours of this time must be spent in a "Continuation School." This law protects the health of our future men and women by guarding them against injurious employment during their childhood.

184. Recreation and Health.—Playgrounds.— To be well and happy boys and girls must have plenty of outdoor exercise. The country boy has plenty of room to play in the open air, but in cities and towns there are thousands of boys and girls who have no place to play except the streets. Here they are in constant danger of injury from teams, automobiles, and trolley cars. With no one to look after them they are sure to get into bad company and to learn bad habits. They form gangs and commit many petty crimes. They are in constant danger of infection from the dirt of the street and from careless companions.

To avoid these dangers progressive cities and towns provide *public playgrounds.* Here children can engage in suitable games without doing any damage to other people's property. The playgrounds are usually looked after by specially trained teachers. The playground team takes the place of the street gang. Instead of fighting against every one else, the boys learn to work together for the good of all. They learn to "play fair" and to respect the rights of others. The outdoor exercise keeps them healthy and strong.

185. Social Centers.—What playgrounds are for children, social centers are for grown people. When people worked fifteen or sixteen hours a day they had no time for recreation. The men and women who work only eight or ten hours a day have plenty of time for play. Like children, many grown people cannot really enjoy their leisure hours except in the company of others. More men go to the saloon in the evening for the sake of company than for the sake of drinking. The social center is a place where men and women may spend their evenings pleasantly without being exposed to the dangers of the saloon and similar gathering places. There are books and magazines for them to read, games for them to play, music, entertainments of various kinds, dancing for those who care for it, and so on. The social center is a sort of club-house for the whole neighborhood, where men and women may go for wholesome recreation, where they become acquainted with their neighbors, and learn to work together for the pleasure and the benefit of all.

186. Hospitals and Sanitariums.—Sickness cannot be entirely prevented. In spite of the greatest care, some people will be taken sick, and accidents will occur in which people are seriously injured. Persons who are ill or who have been hurt cannot always receive proper care in their homes, especially if they are poor. They have no rooms in which surgical operations can be performed. They cannot have a physician at hand all day long. Very often they cannot afford to have a nurse. Nearly all cities and towns have hospitals which supply all of these needs. Sometimes these are supported by the government of the city or state, sometimes they are maintained entirely by the contributions and donations of charitable people. In nearly all hospitals the poor are treated free of charge. The best physicians and surgeons give their time and services freely for this purpose.

Our public hospitals do a wonderful work in helping the sick and the injured to get well. Physicians, surgeons, and nurses are always on duty, so that patients may have immediate attention in every emergency. Many things that can never be supplied in the home can easily be provided in hospitals, and all of these advantages are open to the poor as well as to the rich. Most of our hospitals have public dispensaries which give free treatment to poor people who are ailing, but are able to walk about.

Some hospitals receive all kinds of cases. Others will take special cases only. Our insane asylums are really special hospitals for the care of the insane. There are special hospitals for children, for crippled people, for consumptives, for the treatment of diseases of the eye, and so on. Many of our large cities have special hospitals for contagious diseases. These not only help the sick to get well, but they prevent the spread of contagious diseases.

People who have tuberculosis are much more likely to get well if they can go to a *sanitarium*, a large home or hospital where they can receive special care. Here they are kept in the open air as much as possible, they are carefully fed, and they are taught how to take the best care of themselves in every way. These sanitariums are often maintained by the state government. Pennsylvania now has three state sanitariums, and over one hundred state dispensaries for the free treatment of tuberculosis. These sanitariums prevent the spread of tuberculosis among our people and they help to cure those who have it.

QUESTIONS

Name some things that belong to personal hygiene. Why is it called "personal" hygiene?

Explain what is meant by "public hygiene." Why is public health work necessary?

What things does public health work include? Show why each is necessary.

What are some of the reasons that food is adulterated? Tell some of the ways in which food is adulterated.

Explain how food may become impure through careless handling. Notice how food is handled in the stores and markets to which you go. Tell whether you think any of the food sold in these places becomes impure through careless handling. What can each of us do to put a stop to the careless handling of food?

Explain why food spoils. Why is tainted food unsafe?

Explain how food should be cared for.

Explain all the ways of preserving food that you can think of. Give the reason for each, and tell for what foods it is used. Tell why the cold storage of food is so important in cities.

What are pure food laws? Can you tell why each city and state has its own pure food laws in addition to those of the United States Government? What are the duties of the food inspectors?

Explain why the water supply is a public health problem. In what ways does the government protect us from impure water?

In what ways does the government protect us from impure air?

Show how plumbing is related to health.

Explain why young people should know how one's occupation may affect one's health. What are the most healthful occupations? Name some dangerous occupations.

What poisons are much used in the trades?

In what trades does lead-poisoning occur? How is lead taken into the body? Explain fully how lead-poisoning may be prevented.

In what trades is white lead used?

For what is phosphorus used? How may phosphorus-poisoning be prevented?

What is mercury? Name some of the ways in which it is used in the trades. In what trade are workers most frequently poisoned with mercury? Why? Tell how mercury-poisoning may be prevented.

For what purposes is arsenic used in the trades?

How are phosphorus and mercury usually taken into the body? Name other poisonous fumes and gases to which workers may be exposed. In what trades are poisonous gases and fumes produced? Explain fully how workers may be protected from poisonous gases and fumes.

What is the most common cause of diseases that are due to occupation? Name the trades and occupations in which workers are often exposed to dust.

Name three ways in which dust may cause sickness.

What are the most common of the poisonous dusts?

Explain how stone and metal dust injure the body. In what trades are these found? Give some facts to show how unhealthful these occupations are.

What are the textile industries? What makes them unhealthful? What disease is very common among workers in cotton and linen factories? Why?

What infectious diseases may be caused by dust? How can this be prevented?

Explain fully the things that may be done to protect workers from dust.

What things help to make a healthful workroom? Explain why.

How long should men labor each day?

What restrictions should be placed on the employment of women and children? Why? Should children work at night?

Explain in what ways playgrounds help to preserve health.

What are social centers? What is their purpose? How do they promote good health?

Explain how hospitals are related to the health of a community. How do sanitariums help to prevent the spread of tuberculosis?

INDEX

ADENOIDS, 16, 132
Adulteration of food, 81, 165
Air, 14
    amount needed, 23
    how purified, 20
    kept moist, 28
Air passages, 10
Air-space needed, 23
Alcohol and heredity, 124
    effect of, on ear, 133
        on eyes, 146
        on kidneys, 55
        on lungs, 29
        on nervous system, 122
        on skin, 53
Animal foods, 59
Anthrax, 180
Antidotes, 156
Aqueous humor, 136
Arsenic, 157, 176
Artificial respiration, 160
Astigmatism, 139

BACTERIA, 80, 167
Balanced diet, 73
Bandages, 150
Baths, cold, 49
    warm, 48
Beans, 66
Bedrooms, 28, 117
Beef, 67
Bleeding, 153
Brain, 101
Bread, 65
Breathing, 9-31
Bronchial tubes, 11
Burns, 151
Butter, 69

CARBOHYDRATES, 59, 61
Carbon dioxide, 9, 14, 20, 43
    foods, 59
Care of clothing, 53
    of ear, 132
    of eye, 142-147
    of food, 71, 79-84, 165-170
    of hair, 50
    of kidneys, 55
    of nails, 50
    of nervous system, 112-125
    of skin, 48
    of vocal organs, 29
Cereals, 64
Cerebellum, 106
Cerebrum, 104
Cheese, 70
Chicken-pox, 41
Child-labor laws, 182
Chocolate, 73
Choking, 152
Choroid, 135
Clothing, 51-53

Cochlea, 131
Cocoa, 73
Coffee, 72
Cold storage, 169
Color-blindness, 140
Consumption, 32-40
    and occupation, 179
Cooking, 77
Co-ordination, 106
Corn, 65
Cornea, 134
Correct breathing, 15
Cotton mills, 180
Crossed eyes, 137
Crystalline lens, 134

DAILY rations, 74
Deafness, 17, 132
Defects of vision, 138
Dermis, 44
Diaphragm, 12
Diet, 58-76
Diphtheria, 39
Dislocations, 155
Dog-bites, 155
Drinking cups, 89
Drowning, 160
Dust, 19, 178
    masks, 178

EAR, 130
Education and the nervous system, 120
Eggs, 70
Emergencies, 149-162
Emetics, 156
Epidermis, 44
Epiglottis, 11
Eustachian tube, 131
Excretion, 43
Expiration, 13
Eye, 133
Eye-strain, 140

FAINTING, 152
Far-sightedness, 138, 143
Fat, 54, 62
Fever, 47
Filtration, 92
First aid, 149
Fish, 67
Flushing crowded rooms, 27
Food, 58-84
    amount needed, 63
    care of, 79
    composition of, 71, 72
    elements, 61
    inspection, 81, 169
    preparation of, 76
    preservation of, 68, 80, 168
Fractures, 154
Frost-bite, 159
Fruits, 66

GARBAGE disposal, 96, 165
Gases, poisonous, 177
Germs, 19, 33, 45, 76, 77, 79, 83, 88, 146, 149, 180
Gray matter, 99

HABITS, 119
Hair, 45, 50
Headache, 115
Hearing, 130
Heat exhaustion, 159
Heredity and alcohol, 124
Hospitals, 184
How we breathe, 12
        hear, 131
        see, 137

IMPURE air, 18
  food, 79, 83
  water, 88
Inspiration, 13
Iris, 134

KIDNEYS, 54

LABOR, hours of, 182
Larynx, 11, 15
Lead-poisoning, 157, 174
Lungs, 11

MAIZE, 65
Measles, 40
Meats, 66
Medulla oblongata, 106
Mercury, 157, 176
Metal grinding, 179
Milk, 68, 82–84
Mind and body, 113
Mineral foods, 59, 61
Motor area, 108
Mouth breathing, 17
Mumps, 41
Mutton, 67

NAILS, 45, 50
Near-sightedness, 138, 143
Nerves, 103
Nervous system, 98–127
  health of, 112
  injuries to, 118
Nose-bleed, 152
Nostrils, 10

OATMEAL, 65
Occupation and health, 173
Oil, 54, 62
Opium, 30, 158
Optic nerve, 135
Oxidation, 9
Oxygen, 9, 14, 20
Oysters, 68

PARALYSIS, 109
Pasteurized milk, 84
Peas, 66
Personal hygiene, 163
Perspiration, 46
Pharynx, 10
Phosphorus, 158, 175
Playgrounds, 183
Pleura, 12
Plumbing, 172
Poisoning, 156
  in the trades, 174
Pores, 46
Pork, 67
Potatoes, 66
Poultry, 67
Protein, 59, 63
Ptomains, 68, 168
Public hygiene, 163
Pupil, 134
Pure food laws, 81, 169

RATIONS, 74
Recreation, 183
Reflex action, 109
Refrigeration, 80, 169
Respiration, 9–31
Respirator, 178
Retina, 135
Rice, 65

SANITARIUMS, 184
Scarlet fever, 40
Sclerotic coat, 135
Self-control, 114

Semicircular canals, 131
Sensory area, 108
Sewage disposal, 94
Sewer gas, 172
Shell-fish, 68
Sight, 133
Skin, 43
Sleep, 116
Sleeping-room, 28, 117
Smell, 129
Snake-bites, 158
Social centers, 184
Special senses, 128
Spinal cord, 102
Sprains, 154
Starch, 59, 61
Suffocation, 160
Sugar, 59, 61
Sunstroke, 119, 159
Sweat-glands, 46
Sympathetic nervous system, 107

TASTE, 129
Tea, 72
Temperature of body, 46
    of living-rooms, 29
Tight clothing, 17
Tobacco, effect of, on ear, 133
Tobacco, effect of, on eyes, 146
        on lungs and air passages, 30
        on nervous system, 125
        on skin, 53
Touch, 128
Trachea, 11
Tubercle bacillus, 32
Tuberculosis, 32–39

UREA, 43

VEGETABLE foods, 59
Ventilation, 21–28
Vitreous humor, 136
Vocal cords, 15
Voice, 15
Voluntary movements, 109

WASTE matter, 43
Water, 61, 87–96, 170
Wheat, 64
White lead, 175
    matter, 99
Whooping-cough, 41
Windpipe, 11
Workrooms, 181
Wounds, 149
    of foot, 155